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Paint Tests on U. S. Receiving Ship "Hancock"

By Henry Williams*

The question of protecting from corrosion the bottoms of steel vessels lying alongside docks for indefinite periods is one of importance, especially to the Navy, because of the increasing number of men-of-war that are being placed "in ordinary" or "in reserve," and kept lying thus in the navy yards. The problem differs from that presented by a cruising ship, owing to the necessity, in the latter case, of preventing the growth of barnacles, which impede a ship's motion through the water. On a ship lying at the dock, barnacles prove an advantage rather than otherwise, as they serve to prevent corrosion of the surfaces to which they adhere. There is another point of difference, and one which apparently has not been recognized generally, that is, that harbor water almost always differs enough in quality from sea water as to require paint of different ingredients to resist its action. For example, the harbor water around New York is much less salty than ocean water, and at certain stages of the tide is nearly fresh. It contains, also, many foreign substances discharged by various manufacturing plants, and a fairly large percenage of sewage, the salts of which act on certain paints which resist ocean water successfully.

Another feature of the question of preventing the corrosion of the bottom of steel ships lying at the Brooklyn Yard is the electrolytic action caused by stray electrical currents through the yard and adjacent waters. A large power house of the Brooklyn Rapid Transit Co. is located on the water front, just above the Navy Yard. There are decided evidences of return currents across the yard—so much so that several years ago, on the request of the naval authorities, the Transit Company fitted a bonding cable to minimize the stray currents. While the explanation of the action of the ground currents in causing corrosion on the ships' bottoms here is somewhat obscure, the fact remains that marked local pitting has been found along the waterline on the side and end lying toward the power house. On the "Columbia," and on the "Hancock," which it preceded as receiving ship, the pitting was found at each docking. In order to meet the situation zinc plates were hung from brackets on the side so arranged that the zincs were just submerged. Apparently these zincs have reduced the corrosion considerably, and this fact tends to confirm the idea that it was caused by the electrolytic action of the stray currents.

The Bureau of Construction and Repair of the Navy Department, some years ago, directed that experiments be undertaken at the various navy yards looking to the determination of the best paint for protection of bottoms of steel ships lying in each yard, having in mind the differences in the harbor water at each, and the fact noted above of the increasing number of naval vessels lying practically the whole year around alongside the dock.

At the Brooklyn yard particular cases in point are the receiving ship "Hancock," which has been lying at the yard since 1902, and the battleship "Alabama," which has just left the yard after having been here "in ordinary" since October, 1908, for general overhauling. The bottoms of these vessels have been used to try out the protective paints of various compositions which have shown most promise in preliminary experiments conducted on submerged plates, coal barges, etc.

It has been customary at this yard to dock such vessels once in two years for repainting the bottom and, the two-year period since last docking having expired, the "Hancock" was placed in dock July 9 last. It had been decided previously to take advantage of the opportunity to try out 12 paints which had shown the most promise in preliminary experiments—notably in a similar test on the bottom of the "Alabama," which had been docked in January, 1912, after being out of dock for over one year lying in the Navy Yard. These paints may be taken as representing all of the most important general groups into which protective paints for steel naturally divide themselves.

As mentioned above there is no advantage in preventing the growth of barnacles and other fouling matter on such ships, although the growth of fouling matter in the Brooklyn Navy Yard waters is very slight and confined almost exclusively to soft jelly-fish like growths, the size of a cherry. There are very few barnacles and these die before attaining any size. Further, it is doubtful if any ordinary anti-fouling bottom paint would retain its effectiveness for a period as long as two years, as the poison on which it is dependent to kill the growths would all be dissolved long before that time.

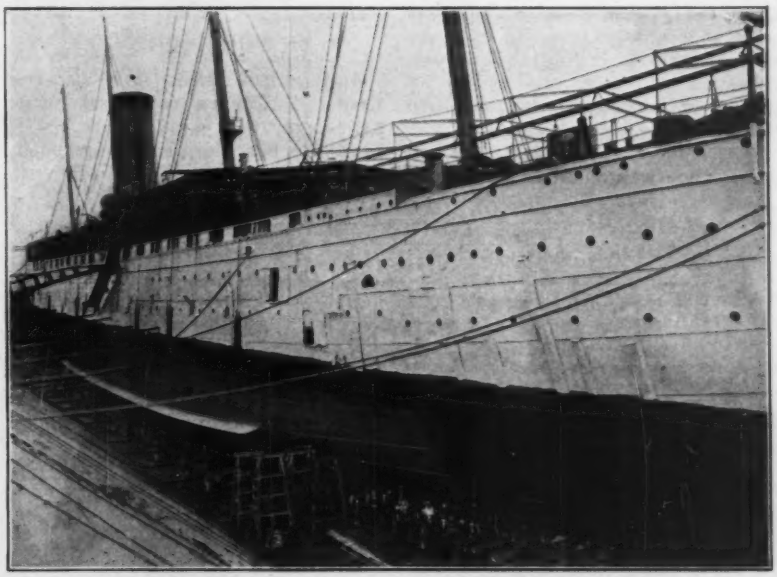

Fig. 1. U. S. S. "Hancock" in Dry Dock After Having Underwater Body Covered with Test Paints

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Having all the above in mind, it was decided at this docking of the "Hancock" definitely to omit the usual coats of anti-fouling ship's bottom paint, and to apply only the protective or anti-corrosive coats. The bottom was divided on each side into six sections, each about 75 ft. in length, and each of these sections was painted with two coats of one of the different paints selected for the experiment. A diagram is appended showing the arrangement and the designations of the various paints. Only two of those used were commercial, all of the other ones being made from formulas developed in the Navy Yard by Albert M. Jordan, Laboratorian, engaged on paint tests.

The paints Nos. 115, 115-A and 115-B are similar, differing only in the pigments. Each has a cooked-varnish vehicle made with rosin, damar gum and linseed oil, thinned with coal-tar benzol. The pigments, which are ground in this, consist for No. 115 of venetian red and a smaller quantity of zinc oxide. In No. 115-A the pigment is exclusively zinc oxide with a small quantity of lampblack for tinting. In No. 115-B the pigments are zinc oxide with a smaller quantity of metallic zinc dust and lamp black for tinting.

The paint No. 116 has a cooked-varnish vehicle made with caledonia gum, damar gum and raw linseed oil, thinned with benzol. The pigment consists of zinc oxide and lamp black for tinting.

Paint No. 234 has a varnish vehicle like that in No. 115, but is thinned with coal-tar naphtha and has some coal tar. The pigment consists of graphite, talc, venetian red and zinc oxide.

Paint No. 236 has a somewhat complex varnish vehicle containing two metallic soaps. It is made with rosin, manganese resinate and zinc tungate melted in a varnish kettle and then thinned with coal-tar naphtha. The pigments are venetian red, talc and lamp black.

Paint No. 100-A has a vehicle of tar oil and varnish made with caledonia gum and rosin cut cold in benzol. The pigments are venetian red, zinc oxide and silica.

Paint No. 38-B has a bituminous-oil vehicle made by heating coal-tar pitch and Trinidad asphalt until liquid and thinning with mineral turpentine substitute and coal-tar naphtha. The pigments are zinc oxide, silica and graphite.

Paint No. 13 has a bituminous-oil vehicle made with coal-tar pitch and Trinidad asphalt heated to a higher temperature until 20% of the volatile ingredients are driven off; then blown linseed oil is added along with manganese resinate and the heating is continued. After cooling the mixture is thinned with mineral turpentine substitute and graphite is added.

Paint No. 14 is identical except that ferric resinate is used instead of manganese resinate.

The two commercial paints used as a basis for comparison of results are "Tockolith," which is a cement paint, and "Rabok," which is a bituminous paint. Both generally have given good results where used on naval vessels.

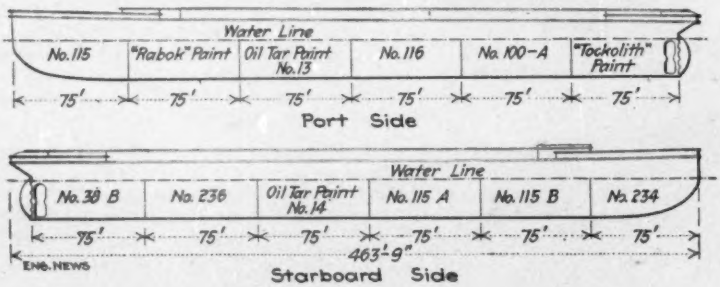


FIG. 2. DIAGRAM SHOWING SECTIONS OF THE BOTTOM OF U. S. S. "HANCOCK" AS COVERED WITH EXPERIMENTAL PAINTS

The New Pumping Installation of the City of Evansville, Ind.*

An important installation of high-duty steam-turbine-driven centrifugal pumps has recently been made for the city of Evansville, Ind. This plant was originally equipped with two 10,000,000-gal. vertical triple-expansion Holly pumping engines having the following dimensions:

Steam End:	
H.p. cylinder	24 in.
I.p. cylinder	41½ in.
L.p. cylinder	61 in.
Water End:	
Top plunger	19¼ in.
Bottom plunger	27¼ in.
Stroke	48 in.

These were put in regular operation in April, 1900, and cost approximately $130,000. On official test, one unit showed a performance of 135,000,000 ft.-lb. per 1000 lb. of steam, and the other 137,000,000.

On account of the necessity of furnishing a better supply than raw Ohio River water it was decided to install a filtration plant. This necessitated low-head raw-water pumps for lifting from the river to the sedimentation basin, as the two Holly pumps took the water directly from the river and put it into the mains. Centrifugal pumps were decided on for this service.

It had been considered in 1900 that the two 10,000,000-gal. pumps would be amply large for the needs of Evansville for a considerable period. But by 1911, the crank and flywheel pumps were very badly in need of repairs, the ordinary daily consumption had increased to such an extent that it was necessary at times to run both units, and the city did not always have sufficient water for domestic service. The ordinary service pressure is 70 lb., but this pressure must be increased to from 120 to 140 lb. on an alarm of fire.

LOW-LIFT PUMPS—Two duplicate units were installed for this service, each having a capacity of 15,000,000 gal. per 24 hr. On account of very wide variations of the river level, the specifications called for a unit capacity of 15,000,000 gal. against total heads varying from 13 to 62 ft., and duty guarantees had to be made for a number of conditions. On account of the large capacity and comparatively low head, the problem of designing the pumps to be driven by steam turbines was difficult.

The driving end of each unit consists of a 260-hp. geared turbine, the pump shaft running at a speed of about 900 r.p.m. Each turbine is directly connected to two 16-in. single-stage double-suction horizontal-type centrifugal pumps which operates in parallel. (On account of lack of head room below the floor level of the pump, the water-works-type surface condensers were placed above the pump-room floor). The condensers are arranged, as can be seen from the accompanying figure, so that the entire quantity of water passes from each unit through its condenser.

On account of very limited space, several nice problems of piping had to be solved. Careful attention was given to the oiling system, as ordinarily these machines will operate without constant attendance, the idea being to have an engineer inspect them once every two or three hours.

Between heads varying from 13 to 62 ft. the duty guarantees ranged from 31,000,000 to 82,000,000 ft.-lb. per 1000 lb. of dry steam. Between heads of from 36 to 62 ft. the duty guarantees ranged from 66,000,000 to 82,000,000 ft.-lb. per 1000 lb. of dry steam. All duty guarantees were made on a basis of charging against the turbine the steam used by the engine driving the vacuum pump. The economy guarantees were made on a basis of dry saturated steam at 140 lb. gage pressure at the turbine throttle.

All pumps were tested at the shop of the manufacturer before shipment, and records of performances with the variable head conditions were obtained.

*From information supplied by J. D. Berg, of the Dravo-Doyle Co., Pittsburgh, Penn.

On account of the fact that these variable conditions could not be obtained at the time of the official test at Evansville, due to the low stage of the river, the pumps were tested only against a head of about 60 ft. at which point duties of 86,800,000 and 86,600,000 ft.-lb. were obtained. These results agreed almost exactly with the shop tests for similar conditions, and the tests for all the variable conditions were accepted as correct.

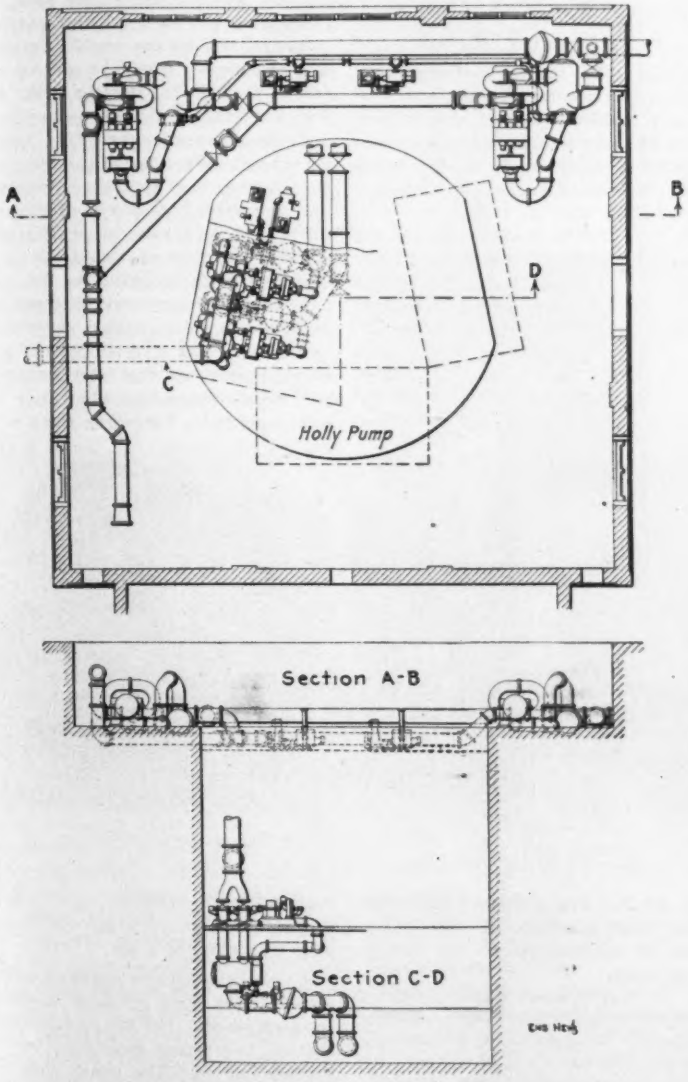
It was impossible to get exactly the same steam and vacuum conditions at the shop test as were present at the installation test. However, by assuming the same thermal efficiency for the turbine, an entropy table made it possible to obtain the following tabulation of probable service duties under variable conditions:

Lb. Steam	In. Vacuum	Ft. Total Head	Gal. per Min.	Ft.-lb. Duty
143.16	27.6	59.3	10997	87,400,000
143.16	27.6	62.0	10700	88,000,000
143.16	27.6	47.7	11020	82,000,000
143.16	27.6	37.2	10760	76,300,000

This pump at the test at Evansville when operating against a total head of 59.45 ft. discharging 10,504 gal. of water per minute, with 143.16 lb. average steam gage pressure and a vacuum of 27.6 in. referred to 30 in. barometer, showed a duty of 86,800,000 ft.-lb. per 1000 lb. of steam. In other words, for practically the same head and capacity conditions, there was a difference between factory and plant test of less than 0.7%, which might easily be accounted for by changed observers, or a slightly higher speed at the factory test as is shown by the higher capacity. The above tabulation it must be understood is made on the assumption of charging 270 lb. of steam per hour, used by the engine driving the air pump, against the turbine. If this is not done the following data are obtained:

Steam	Vacuum	Head	Capacity	Duty
143.16	27.6	59.3	10997	94,400,000
143.16	27.6	62	10700	94,900,000
143.16	27.6	47.7	11020	89,500,000
143.16	27.6	37.2	10760	85,200,000

In other words for a reduction in head of 40% the duty is decreased by only 10.2%.



LAYOUT OF TURBINE-DRIVEN PUMPS, EVANSVILLE, IND.

DOMESTIC-SERVICE AND FIRE-PRESSURE PUMPS—Two units were installed for this service. Each unit consists of a 575-hp. geared steam turbine direct-connected to two 20-in. single-stage double-suction centrifugal pumps arranged for series operation, as can be seen from the accompanying figure. The units are so arranged that either can be run on domestic service, with a capacity of 15,000,000 gal. per day against a total head of 162 ft.; both units can be run on domestic service giving a capacity of as much as 30,000,000 gal. per day against a total head of 162 ft.; or the pumps of both units can be operated in series giving a capacity of 15,000,000 gal. per day against a total head of 324 ft.

Each unit is provided with a water-works condenser with water outside the tubes, and steam on the inside. Each condenser is provided with an air pump driven by a 5x5-in. vertical engine. Each air pump is large enough to handle the condensate, air, and vapor from the two condensers. They were so provided in order that on an alarm of fire the second air pump would not have to be started, as it is desirable to obtain fire pressure as quickly as possible after the alarm. (Without any preparation of the operators, fire pressure can be obtained in a little more than one minute after an alarm is received.)

The air pumps are provided with small centrifugal pumps belted off the main shaft; these discharge the condensate to open feed-water heaters. Ordinarily the engine driving the air pump runs non-condensing, exhausting into the heater, but during all tests it exhausted into the condenser, as the turbines were charged with the steam used.

In consideration of their size the results obtained by these units are noteworthy. The following data were obtained from the test at Evansville:

	Pump No. 1	Pump No. 2
Duty (ft.lbs.)	110,553,000	111,163,000
Total Head (ft.)	162.12	163.58
Capacity (Gal. per min.)	10,363	10,390
Steam Pressure (lb. gage)	141.6	147.9
Vacuum (ins.)	27.9	28.2
Barometer (ins.)	29.4	29.75
Speed pumps (r.p.m.)	830	846
Temperature water into condenser (F°)	68.9	68.9
Temperature water, out of condenser (F°)	70.7	70.7
Temperature condensate, (F°)	77	77
Height condensate discharge above hotwell pump (ft.)	35.1	35.5

The above results correspond to the results obtained at the factory test almost exactly. The units were also run under variable head conditions, the capacity being kept constant, and with a reduction in head of 32% from the designed point, the duty varied only 9%, whereas a reduction of 15% in head with constant quantity resulted in a decrease in duty of only 4%.

GENERAL NOTES—Each test was run five hours, careful readings being made every 10 minutes. Suction readings and discharge heads of the low-head pumps were taken with mercury columns. Discharge pressures of the high-head pumps were taken by gages, calibrated before and after the tests. Quantity of steam used was determined by weighing the vacuum-pump discharge. Water pumped by the low-head pumps was measured by a calibrated pitometer. Water pumped by the high-head units was measured by simplex meters, which on calibration, were shown to be within 0.4% absolute accuracy.

The duty of the two units when operating in series against a total head of as much as 324 ft. discharging 15,000,000 gal. of water per day will be exactly the same as the duty of the units on domestic service.

From the results obtained from the various tests at Evansville and at the factory, the duties of the turbine for various capacities lower than normal capacity against the normal head were as follows:

Daily Capacity	Duty	Per cent of Normal
15,000,000	110,000,000	100
10,000,000	105,000,000	95.5
5,000,000	78,000,000	71.0

The cost of the four turbine-driven pumps with condensers, etc., erected was approximately $50,000. Of this amount the two high-head pumps cost approximately $30,000.

It makes a very nice problem to compare these high-lift pumps with triple-expansion direct-acting pumps for similar conditions, taking into consideration the total operating cost, and interest and depreciation on the two types of apparatus.

Alvord & Burdick, of Chicago, were Consulting Engineers on this contract; Dravo-Doyle Co., of Pittsburgh, made the installation; Fred J. Postel, of Chicago, under the direction of Alvord & Burdick, made the official duty test. The turbines and pumps were manufactured by the De Laval Steam Turbine Co., of Trenton, N. J.

Electric-Propulsion Equipment of the U. S. Collier "Jupiter"*

In July, 1911, the U. S. Government closed a contract for the equipment of the naval collier "Jupiter" with a system of electric propelling machinery proposed and designed by W. L. R. Emmet, of the General Electric Co., Schenectady, N. Y.

The "Jupiter" is a sister ship to the twin-screw colliers "Neptune" and "Cyclops," the former having a turbine connected to each propeller through a mechanical gear held in a floating frame†. The "Cyclops" has two triple-expansion engines. These vessels have a displacement of about 20,000 tons, carry 12,000 tons cargo, and are designed to operate at 14 knots. The principal data concerning the equipment of these three vessels is summarized in the accompanying table.

	"Cyclops"	"Jupiter"	"Neptune"
Displacement, tons.	20,000	20,000	20,000
Indicated h.p. at 14 knots.....	5,600	.....	.....
Engine or turbine r.p.m. at 14 knots.....	88	2,000	1,250
Propeller r.p.m. at 14 knots.....	88	110	135
Weight driving machinery, tons...	280	156	.....
Character of driving machinery..	2 Triple Expansion Engines	1 Turbo-Generator and 2 Motors	2 Turbines each with gearing
Steam consumption, lb. per shaft hp.-hr....	14 (estimated)	12 (tested)	.....

The electrical installation proposed for this collier is similar in general schemes to that proposed for battleships but much simpler. The requirements of the collier are to operate continuously for long periods at a speed near the maximum, so there is no particular need for high economy at low speed. It then becomes desirable to simplify the equipment as much as possible consistent with good economy at the normal operating speed, 14 knots. Therefore, only one generating unit and two motors are used. For comparison, in a battleship two generating units and four motors would be provided, so that economy would be secured at all speeds by operating for the lower speed with one-half of the apparatus in use.

In the contract for the collier "Jupiter" the manufacturers had to guarantee under penalty the time of delivery, the water rate per shaft horsepower at 10 and 14 knots, and also that the weight of the electrical equipment would not exceed that of engines proposed for the ship.

In case the machinery is rejected due to failure to meet contract requirements, all the apparatus is to be removed by the manufacturer so that the government may install the engines which were originally intended. Therefore, the electrical machinery was made to conform in outline to the engine layout; this was possible with room to spare.

All of the apparatus has been built and tested at the shop previous to shipping for installation. The test results indicate that all guarantees have been met with a large margin. The water rates at 14 and 10 knots are, respectively, .12 and 14.2 lb. per b.hp.-hr., which is about 1 lb. better than the guarantee. The actual weight of equipment is 156 tons, a saving of about 40% over the reciprocating engine proposed. The main generating unit is a 6-stage Curtis turbine driving a bipolar alternating-current generator. At 14 knots, the speed of the unit is about 2000 r.p.m. and the voltage about 2200. The turbine has been designed to be especially accessible; new buckets can be attached to any of the wheels by simply removing the top half of the casing. Any

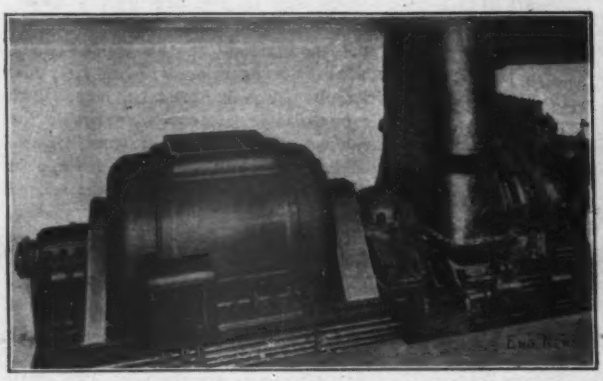


Fig. 1. Steam Turbine and Generator

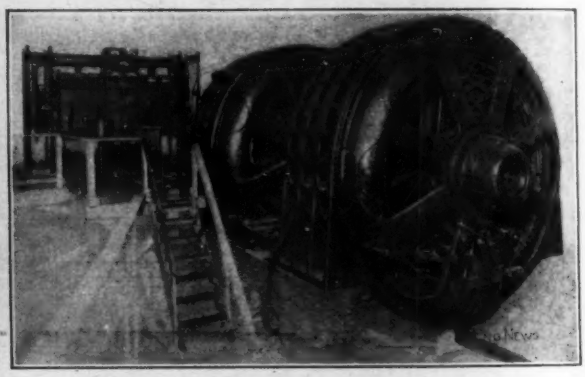


Fig. 2. Induction Motors (In Shop Tests)

PROPELLING MACHINERY OF U. S. COLLIER "JUPITER"

*Arranged in part from an article in the "General Electric Review," July, 1911, in part from American Institute of Electrical Engineers papers by W. L. R. Emmet, and in part from correspondence.

†See Engineering News, May 25, 1911, p. 638.

one of the six stages will run the ship at about half speed, so that the loss of one or more stages will not entirely disable the vessel.

The generator is a 5450 kv.-a., 2300-volt machine with a solid forged field (rotor) spider with a distributed field winding of copper strips insulated with asbestos and mica, being absolutely fireproof. The end windings are held in place by a one-piece nickel-steel ring, on the outer end of which is mounted a fan which draws air in from the bottom of the machine through the air gap, and forces it through the stator air ducts to the top of the generator, where it is led away. The armature (stator) is wound for 2300 volts with a regular bar winding (Y-connection), each slot having two bars insulated with mica and asbestos. The core is of laminated silicon steel. At first thought, this voltage will seem high to many for use on shipboard, but it has been selected by the designer as being the most convenient and economical one in the design and operation of the equipment. With apparatus of this size, voltages of 2000 to 3000 give very simple windings and yet with no possible insulation troubles. The conductors are of reasonable size and the connections simple and direct; the cables carrying currents from the generator to the motors are of moderate size and the small currents bring only small self-induction. The switching devices are light and easily handled without danger of burning the contacts or other difficulties which are sometimes involved in the switching of very large currents. The windings of the generators and motors are entirely closed and the circuits are only a few feet long and entirely concealed, so that there is no possibility of danger to persons operating the apparatus. With apparatus of similar size and voltage, insulated in a similar manner, there has hardly been a case of insulation failure in the 15 years' experience of the manufacturer. As the alternating-current apparatus is connected to no extensive transmission or distribution systems, there can be no high-frequency disturbances of the kind ordinarily met with and the arrangement of the machinery is such that there be no heavy rushes of current.

The generator delivers current to two motors, each a 2750-hp., 110-r.p.m., 2300-volt, 36-pole type. The motors are directly connected to a propeller shaft. They have wound rotors and slip rings for inserting external resistance into the rotor circuit. Each motor is framed entirety of steel; the stator spider is a casting subdivided into four sections. Silicon steel is used in the core laminations. The stator has two coils per slot, formed of rectangular conductors insulated with mica and tape, and varnished to render them waterproof. The rotor is wound with two bars per slot, the insulation being similar to that of the stator. The ratio of synchronous speed reduction between generator and motors is 18 to 1, the propeller turning at 110 r.p.m. for a ship's speed of 14 knots per hour.

The external resistance is connected in series with the rotor circuits during the process of reversing, and also when maneuvering the boat. For straight running the rings are short-circuited by a slider on the motor shaft, operated by a lever attached to the frame of the motor. The resistances are made up of grids of non-corrosive metal mounted in series on an insulating barrel through which sea water is pumped in straight contact with the resistance grids. This amounts to grounding the neutral of the motor-secondary circuit.

The generating unit and motors are self-lubricating and self-ventilating. Sheet-metal ducts will be connected to their air outlets in such a manner that

FIG. 3. WATER-COOLED RESISTANCE UNIT FOR ONE MOTOR

the heated air will be led to the suction of the fire-room blowers and so will not be released in the engine room to raise the temperature there.

Although the generator is of special design, with rather high armature reaction and relatively low ampere turns per pole so that the short-circuit current is small, additional mechanical or electrical interlocks have been provided in order to prevent the closing or opening of wrong switches. Thus, it is impossible to close the "ahead" switch if the "astern" switch is closed, and neither switch can be closed without the resistance being in series with the motor armature for starting. Magnetic locks, energized by the field circuit of the generator, are attached to the levers which insert and cut out the resistance. These locks prevent the movement of these levers until the generator has lost its field, thus preventing any possibility of burning contacts by switching at the wrong time or improperly. This involves momentary cessations of power input. While the apparatus is designed to sustain the loads due to short circuiting the resistance, yet the intermediate step was thought desirable—for a time at least.

There are two distinct operations of the control equipment for operating the ship. The first is the maneuvering position, in which the resistances are continuously in the circuit of the motor rotors. Thus connected, the motors can be started, stopped or reversed practically instantly by simply opening or closing the proper switches, while the boat can be run at any speed up to about 9 knots. In the second position, which is the normal running position, the motors are run without resistance in the armature circuit; the change in the speed of the motors necessary for changing the speed of the vessel is secured by varying the speed of the generating unit, the ratio of speed reduction remaining practically fixed at 18 to 1. This change of generating-unit speed is not made by throttling, as is usual with ship turbines. Instead, the turbine is equipped with a governor of novel construction arranged to hold the speed at any desired point from about 5 knots up to 14, the maximum. The voltage and frequency of the current varies directly as the speed of the main unit. Thus the frequency varies from 15 to 33 and the voltage from 1100 to 2200, voltage and frequency varying together.

In the shop tests of this equipment, previous to shipment for installation, the two motors were set up in the factory, the turbine connected to a condenser, and one motor installed in the same position relative to the switchboard-controlling mechanism that it would occupy on board ship. The other motor was run as a second generator and was mechanically coupled to the first motor as a load, in place of a propeller. By this loading-back arrangement it was possible to test the motor for all conditions under which it might operate on board ship and to show the ease with which it could be started, stopped and reversed. The water rates of the turbo-generator unit were taken under the exact conditions of operation, viz., 190 lb. steam gage with 28½ in. vacuum, the generator being loaded on a water resistance in the usual way. The accompanying figures show the characteristic curves of the motor as tested and the estimated performances of the collier "Jupiter" as compiled from data of tests on the generating unit and motor.

The contract price of the electrical propelling machinery for the collier "Jupiter" was $13.75 per hp., which compared favorably with the cost of reciprocating engines supplied to the "Cyclops," although not as favorable a showing as possible for larger ships.

Dredges Operated by Oil Engines

The use of oil engines for operating dredges is a departure which has been made in the interest of economy in cost of fuel and operation. Two dredges of this class are described in the following article, the machinery equipment and arrangement of the second having been modified in view of the experience with the first. Neither dredge is operated entirely by oil engines, however, there being a steam engine for swinging the boom and gasoline-engine air compressor for auxiliary functions.

A somewhat new line of development in the application of internal-combustion engines is the operation of dredges, and two dipper dredges operated in this manner are now at work on drainage ditch excavation in Iowa. The dredges are in general standard designs of the Marion Steam Shovel Co., which supplied the machinery, the special feature being the application of oil engines instead of steam engines for the hoists. The engines were supplied by Fairbanks, Morse & Co. The dredges were built for DeWitt C. Stephens, contractor, of Buffalo, N. Y., and the design of the hull was modified to suit the engine equipment. The entire work of constructing and erecting the dredges was under the direction of H. B. Whitney (Villisca, Ia.), General Superintendent for Mr. Stephens. To Mr. Whitney also is due the design of the hull, and all changes from standard machinery equipment, including especially the use of compressed air in raising steam in the auxiliary boiler. The two dredges were put in operation in February and July, respectively.

The First Dredge

The first of the two dredges was built at Villisca, Ia., during the winter of 1911-12, and was put in operation in February, 1912, as noted. It is an ordinary ditching machine with a 2-yd. dipper, 42-ft. dipper handle, 60-ft. boom and inclined telescopic bank spuds. The hull is of timber, 85x28 ft., and 7 ft. deep. The machinery is of the double-hitch type, and is driven by a two-cylinder vertical oil engine of 100 hp. The engine is placed near the stern, with its shaft on the center line and driving the transverse pinion shaft of the main hoist through a single pair of bevel gears. This engine drives the hoisting, backing and spud machinery, the circulating pump and the air compressor which supplies air for starting the main engine. The swinging of the boom is independent of the other motions, the two drums for the swinging cable being driven by a two-cylinder 7x8-in. reversible steam engine. Steam is supplied from a vertical boiler of 32 hp., which uses oil fuel.

In working, this first machine proved to be quite satisfactory and to have ample power. As connection between the engine and the machinery is effected through a friction clutch, no trouble was experienced when the dipper encountered heavy frozen ground and buried logs, the clutch slipping when the strain became too heavy. The 2-yd. Marion dredge of this class is estimated to be capable of lifting 40,000 lb. at the dipper. An air compressor furnishes power for starting the engine, and is of sufficient capacity to operate also a ram for setting the friction bands on both the hoisting and backing motions, the backing ram being fitted with a needle valve in order to reduce the shock when going into action. The bottom of the dipper is tripped by a chain connecting the latch with the backing cable. There was at first some doubt as to the advisability of using compressed-air rams to set the friction clutches with an engine running at 250 r.p.m. and geared at a ratio of 10 to 1, but no trouble has been experienced in this respect. The operation of this machine was so satisfactory as to lead to the construction of the second machine, in which several new features were introduced.

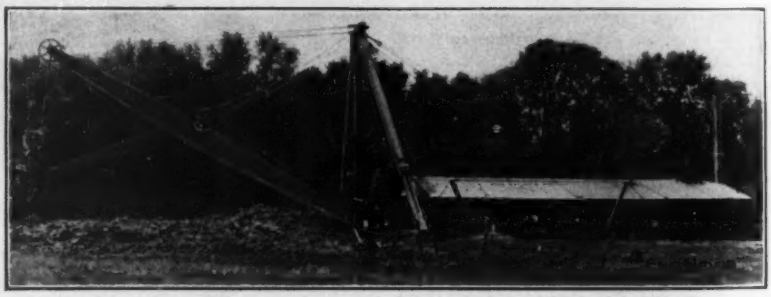


Fig. 1. 3-yd. Dipper Dredge Operated by Two 60-hp. Oil Engines (Storm Creek Drainage Ditch, Iowa)

The Second Dredge

The second and larger dredge was built at Carroll, Ia. (adjacent to the work for which it was intended), and in general type is similar to the first one. It has a 2½-yd. dipper, 50-ft. dipper handle, 75-ft. boom, and inclined telescopic bank spuds. The hull is of wood, 96x36 ft., its depth tapering from 7 ft. 6 in. at the bow to 5 ft. 6 in. at the stern. The boom support casting is 10 ft. 6 in. from the bow, and the center of the machinery load is 47 ft. farther back; behind the machinery there is practically no load. On account of this arrangement of the load the hull was bagged or made 3 in. low at the center of its length, while on the ways (and before calking the bottom), and was hog-chained (or trussed) to hold it down. The hull sits straight on the water, being practically level from bow to stern, and has a freeboard of about 3 ft. 6 in. The cabin or housing is made very low, in order to insure greater warmth during winter work, both for comfort and to prevent the freezing of pipes. In summer, the sides of the housing are removed.

The hoisting machinery proper is of the standard Marion type, except that the pinion shaft is heavier and longer. This shaft is extended at the left end to permit of applying a friction clutch, and at the other end for a clutch and two belt pulleys; one pulley is for driving a 2½-kw. dynamo and the other for the circulating pump. The power for hoisting is furnished by two single-cylinder horizontal oil engines of 60 hp. each, placed at opposite ends of the pinion shaft, with their crankshafts in line with this shaft. The engines are entirely independent of each other, and each is connected to the pinion shaft by a friction clutch. This arrangement eliminates the intermediate bevel gear of the other dredge, and the horizontal engines are considered preferable to the vertical engine as they are more easily held in position on account of their lower center of gravity. The engines and machinery frame are bolted to a foundation platform consisting of nine 12x12-in. transverse timbers laid close together and bolted to the sides and bulkheads. This is done in order to maintain proper alignment of the crankshafts with the pinion shaft.

The engines are started by air. For this purpose there is a small air compressor driven by a 2½-hp. gasoline engine with two 20x60-in. receiver tanks for storage. These air tanks carry a pres-

sure of 160 lb. One of the engines may be started with air and the other by throwing in the clutches. The dredge is operated by the usual hoisting and backing levers, no throttle being necessary for handling.

The swinging machinery is independent of the hoist machinery, and is of the ordinary type. The drums are mounted on the ends of a long transverse shaft, with direct cable leads to the 21-ft. swinging circle. The drum shaft is driven by a two-cylinder reversible steam engine having 8x8-in. cylinders. The steam is furnished by a 54-in. vertical boiler of 40 hp., which is fitted with a Kirkwood oil burner and is fired by the same grade of oil as that used in the oil engines. The boiler feed pump is operated by steam, using the circulating water from one of the engines; this water is heated to 180° by the circulation. Both boiler and pipes are covered with asbestos. A steam drum separator, 24x20-in., was placed on the main steam pipe with stop valves on both sides of the drum.

In order to raise steam, the air compressor is connected to the steam drum and the oil burner by means of the air pipes from the tanks. The stop valves on the main steam pipe are closed and the drum filled with air. From this the oil burner pumps and boiler feed pumps are started. The compressed air is used also to set the rams of the friction bands on the hoisting and backing drums, and to turn over the swinging engines. It is used also in making the repair work ordinarily done on Sundays.

The forward spuds are inclined, of the telescopic type; the steel sleeves are attached to the head of the A-frame and in them slide oak spuds, 15½x17½ in., fitted with bank shoes which are braced from the feet of the A-frame. The rear spud is a vertical oak timber 18x18 in. All are operated by cables. The spud hoisting machinery is placed alongside of the main machinery, and consists of three drums compound geared and driven through cone friction clutches;

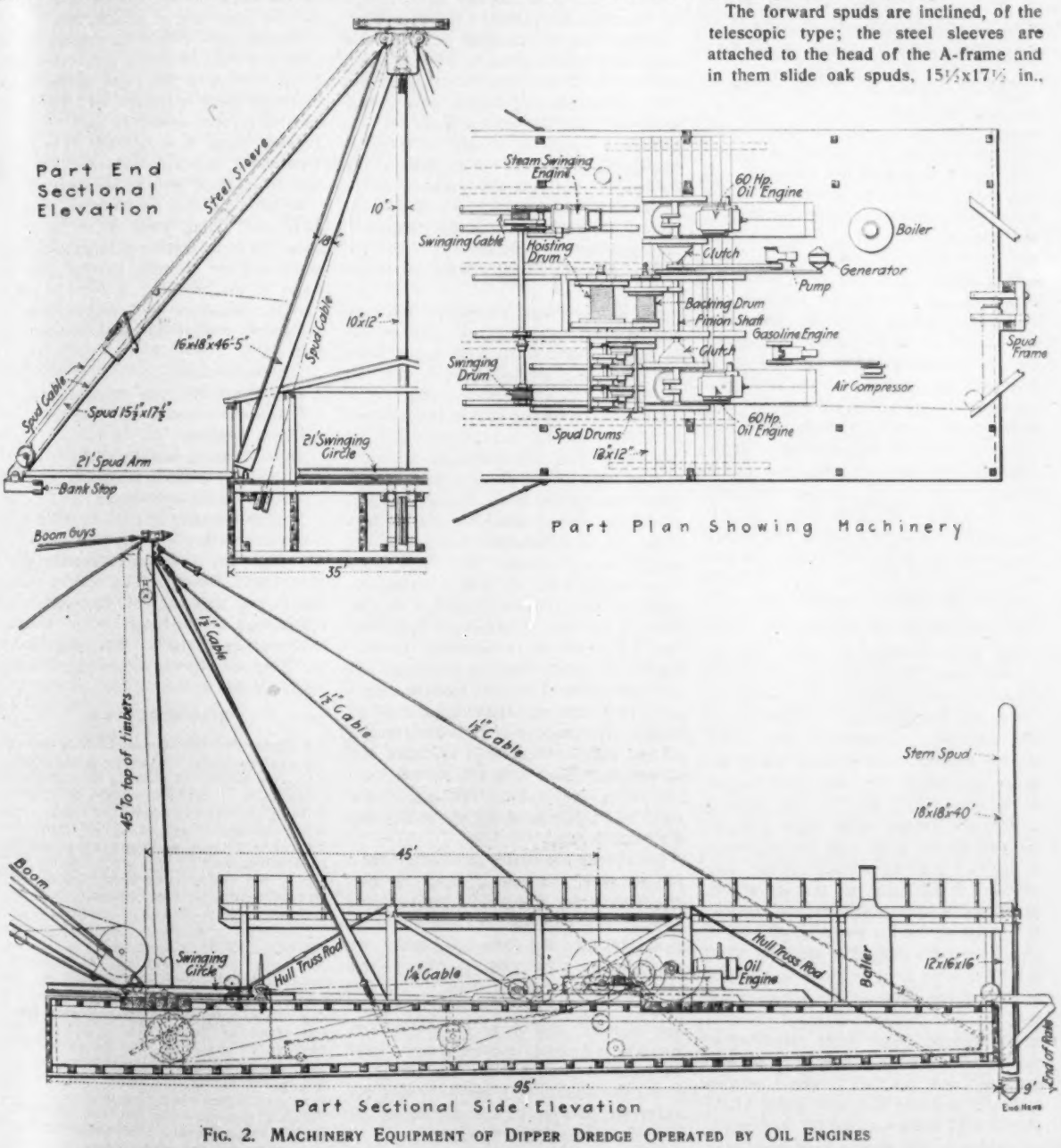


FIG. 2. MACHINERY EQUIPMENT OF DIPPER DREDGE OPERATED BY OIL ENGINES

the shaft carrying the cones is operated from the end of the backing shaft by spur gears, through a friction clutch of the inside expanding type, which is set by hand. The equipment includes a duplex boiler-feed pump capable of handling water at 160°, and a bilge siphon for draining the hull. For lighting there is a 2½-kw., 32-volt dynamo, and a 40-amp.-hr., 32-volt storage battery of the portable type to supply current when the generator is not running.

The oil engines run at 188 r.p.m. and the hoisting drum at 25 r.p.m. At this speed, the dipper is loaded, swung, dumped and set for loading in 40 sec. This speed is maintained regularly. If the dipper strikes a heavy obstruction the friction clutches slip before starting the engines. However, these clutches give as heavy a pull as the 75-ft. boom should stand before they slip. The drum diameters are 27½ in. for the hoist, 22 in. for the backing, 23 in. for the swinging and 17 in. for the spuds. The hoisting and swinging cables are 1¼ in. in diameter; the backing and forward spud cables, 1 in.; rear spud cable ⅞ in. The hoisting and backing sheaves are 60-in. diameter, and the bail sheave is 36-in. diameter; all are of cast steel with bronze bushings. The dredge can excavate to a depth of 22 ft. below the water surface, and can dump the bucket at a height of 27 to 30 ft. above the water, with a reach of 70 to 75 ft. from the center of the hull to the dump.

Performance of Dredge No. 2

The larger dredge was built for use on the Storm Creek drainage ditch in Carroll County, Iowa. This work involves the excavation of 1,250,000 cu.yd. The material is deposited on the banks, leaving a berm of 15 ft. clear width between the top of the ditch and the toe of the spoil bank. Mr. Whitney informs us that the dredge began work July 29, working double shift, and has continued in regular service without giving any trouble. It has made an average of 260 cu.yd. per hour on a fuel consumption of 11 gal. of oil for the engines and 11 gal. of oil for the boiler. The oil costs $3.76 per 100 gal. on cars, or about 5c. per gal. on board the dredge. This makes the cost for fuel 0.004c. per cu.yd. of material dredged. He states also that if the machine used steam engines for the hoist and coal for fuel it would require 9 tons of coal per 24 hours, which would give a fuel charge of 0.009c. per cu.yd. of material. The results have been very satisfactory, and in a wider ditch it is expected that the dredge will do even better, as the present ditch is rather narrow for the size of the dredge.

The crew on each shift consists of four men, as follows: One man to operate the oil engines and boiler, one runner, one cranesman, and one deck hand.

Stone Ballast*

Rock ballast should be made from hard, tough, durable trap, flint, or limestone rock, or other hard stone. It should be broken to cubes, the maximum of which will pass through a 2½-in. ring and the minimum will not pass through a 1½-in. ring. The crushed stone should be free from screenings, dirt and rubbish.

Ballast can be handled in side-dump cars with flat bottoms, or in coal cars, but drop-bottom ballast cars will secure very good results. Ballast after being unloaded should be handled with a spreader. The track should be prepared by digging out the old ballast down to the bottom of the ties, and rounded up to ½ in. above the bottom of the ties in the center. This will keep the ties from running together until the track is filled with stone. This should be leveled off at the ends of the ties.

All decayed ties should be removed and replaced with new ones. Ties should be properly spaced and track put to gage, and all spikes driven down so that the ties will be tight up to the rail. Then crushed-stone ballast should be unloaded to fill between the ties in the center of the track. This will help keep the track in line and prevent the ties from bunching. About 8 or 12 in. of stone ballast should be placed under the ties if possible, and a minimum depth of 4 in. should be maintained.

In raising track on a 9-in. raise, the track can be put up in one lift if a large force of men can be secured. Ordinarily the track is put up in two lifts. In raising in one lift the foreman in charge will soon learn how many rail lengths a train of 15 or 20 cars will raise to the required height. The number of rails are counted off and sufficient ballast is unloaded and plowed out. Four men are started making places for jacks. One end of the sight board is placed on the stake, and the board leveled.

Four jacks are used; two being half a rail ahead of the others. The first pair raises the track about half the required height. No tamping is required with these jacks, as the stone runs under the track by its own weight. The second pair of jacks raise the track to the full height. A force of 20 men should follow to tamp, and these should be followed by a foreman and eight men to put the track in perfect line. The first half of the day should be given to raising the track, the balance of the day being devoted to tamping and lining.

Where two lifts are made, the ties should be tamped with shovels their entire length. After the second lift, the ties should be tamped with tamping picks or bars, the tamping extending from ends of ties to 12 in. inside of rail. Particular attention should be paid to tamping under the rail, but the center of the ties should not be tamped.

In dressing up single track with ballast, the ballast should be filled in at least within 1 in. of top of ties and sloped from ends of ties. The edge of ballast slope should not be less than 4 ft. from gage line of outside rail.

Double track should be dressed in the same way, the stone in the center ditch being level with the stone in the track. When the track is bonded for electric signals, it is very desirable that the stone be kept below base of rail. The track, after being raised, should be left from four to six days before dressing.

In handling 600 to 1000 yd. of stone daily and giving track 9 to 12 in. of raise, the force employed largely depends on the amount of traffic handled, and the views of the officials. A force of 40 to 50 men should be used, and a force organized as follows will give excellent results:

1 Chief foreman.
1 Assistant foreman to raise track.
1 Assistant foreman to line track.
2 men flagging.
4 men digging out for jacks.
13 men on jacks (4 digging holes, 8 on jacks, 1 with levelboard).
20 men tamping.
8 men lining.
1 water boy (or more if necessary).

Minority Report—The size of stone which the majority of the committee recommend is too large for the maintenance of good track. The size should run from 1¾ in. maximum to ½ or ¾ in. minimum.

*Abstract of committee report presented at the annual meeting of the Roadmasters and Maintenance-of-Way Association, Buffalo, N. Y., Sept. 10-13.

A Meter for Compressed Air is now on the market under the name of the Excelsior Airometer. It consists of a series of small fans or turbine wheels alternating with stationary guide-vane rings, the whole being inclosed in a cylindrical casing. The record dials are graduated to read cubic feet of free air. The capacities of the dials range from 10,000,000 cu. ft. on the smallest size to 100,000,000 on the largest.

Provision is made for throwing the recording dials in or out of gear so that the airometer may be used for tests of the air consumption of pneumatic tools, for example, by throwing the dials in gear for say one minute and then throwing them out of engagement. The change in the reading of the dials will then represent the consumption of the tool being operated in cubic feet of free air per minute. It is suggested that this feature will be useful in determining the effectiveness of repairs on pneumatic tools before sending them out from the repair shop.

The airometer is built in eight sizes with capacities of from 125 to 10,000 cu. ft. of free air per minute. It is claimed that the accuracy of the device is not affected by the pressure and that it can be used for pressures of from 50 to 150 lb. per sq. in. The airometer is manufactured by the Excelsior Drill and Manufacturing Company, Empire Bldg., Denver, Colo.

A Summary of Eight Years Work on the New York State Barge Canal

By Emile Low*

By a referendum of Nov. 5, 1903, the people of the State of New York authorized the construction of the so-called Barge Canal, an enlargement of the Erie, Champlain and Oswego sections of the state canals, the design of which has been fully described in previous issues of Engineering News, particularly in that of June 9, 1910, p. 663. There has been prepared and presented below a resumé of the work done in the construction of the canal in the eight years which have elapsed since work commenced.

Preliminary Work

Within a short time after the ratification of the canal referendum, the work of organizing an engineering force and of making surveys and plans was begun. This included parties in the field making surveys, soundings and borings for the actual line of the canal, as well as of watersheds for proposed storage reservoirs. In addition a large number of water gages were established and their readings taken daily in order to determine the flow of all streams where waters were likely to be used for the new canal. A large force was also employed in the head office preparing detailed plans and estimates for locks, movable and fixed dams, bridges, culverts and the various structures and other work required to complete the contract plans for the various sections of the canal.

First Contracts

The progress on the contract plans was such that a large number of proposals were opened in December, 1904, by the Superintendent of Public Works for contracts Nos. 1 to 6, inclusive, covering a distance of about 24 miles. These six contracts took in all of the various classes of work unless possibly some of the extremely hard rock excavation in the vicinity of Little Falls, and the hardpan that had heretofore been found on the Western Division of the Erie Canal between Brockport and Medina.

Contracts Nos. 1 and 3 were in the Champlain Canal north and south of Fort Miller, and contract No. 2 in the Erie Canal at Waterford. They included three locks, one dam across the Hudson River, one guard lock, typical prism excavation, the upper stratum of earth and the deeper cutting of hard, tenacious, Hudson River shale, and typical river dredging along the Hudson River. Contracts Nos. 4, 5 and 6 were in the Erie Canal, the first from the head of Oneida Lake some 5 miles easterly, the second, in the Seneca River at Fox Bridge, both embodied typical hydraulic dredging. The third included extremely heavy cutting near Rochester, 35 ft. in depth. The material is rock overlaid with earth.

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TABLE I

Contract No.	Engineers Estimate	Contractors Bid	Final Estimate
1	$619,846	$605,008	.....
2	1,022,640	852,330	.....
3	760,576	670,497	633,290
4	812,560	726,815	720,073
5	421,252	381,988	.....
6	1,381,662	1,005,982	1,033,864
Totals	5,018,536	4,242,620	

Prominent contractors were well represented in the proposals received for these six sections of work, including firms from Philadelphia, New York, Chicago, Pittsburgh, and other sections of the United States.

The proposals submitted by the lowest bidders—to whom these contracts were awarded—were on an average of about 15% under the estimates of the State Engineer.

Table I shows the Engineer's estimate and successful contractors' bid.

Owing to certain alterations, Contract No. 1 was reduced to $580,424, and on June 1, 1912, was 81.8% finished. Contract No. 2 was relet, making the revised total $1,252,402; it is 75.5% finished. Contract No. 5 was suspended, owing to an alteration in the location, $125,820 having been paid out.

For the first time in the history of the New York canals; contracts have been let which provide only one price for all kinds of excavation. In contracts Nos. 1 to 6, as well as in all subsequently let, no attempt was made to classify the different material excavated, such as earth, rock, hardpan, etc. The results have been very satisfactory in every way. Contracts have been awarded at prices as low as probably would have been obtained under the old method of different prices for earth and rock excavation, and in the actual execution of the contracts there has been no occasion for the frequent disputes and differences of opinion so common under the old method, as to just what material should be classified as earth or as rock.

To enable contractors, before bidding, to ascertain the quantities of different classes of material which the plans required to be excavated, it was thought advisable to make an exhibit to the contractors of a very complete set of borings over the area of each contract. For this purpose a large number of wash drills were constructed and crews organized for their operation, each under a competent foreman with two or more assistants. Samples of the borings were taken at regular intervals and preserved in glass bottles properly labeled. These wash drills were used for drilling through the earth until rock was reached. On all structures where rock excavation was required, the character and nature of the rock was determined by borings made in the rock by shot drills and the cores of the rock were carefully preserved and exhibited to all bidders for each contract.

Water Supply Contracts

Of the two great reservoirs*, that at Delta, on the Mohawk River north of Rome, is being constructed by Arthur McMullen under contract No. 55, dated Oct. 19, 1908. The engineer's estimate was $1,014,525; the contract price, as affected by alterations, $945,840. To June 1, 1912, there has been paid on the contract, $873,020, the work being 92.4% completed.

The contractor for the Hinckley Reservoir is the Buffalo Dredging Co. The contract is No. 50, dated Sept. 23, 1910. The engineer's estimate was $1,076,000; the contract price, $974,529. The work done to date is $156,560, and is 16% done.

Progress of Contract Work

Table II shows the annual progress in contract work for the years 1905-1911.

During the year 1911 construction work to the value of $15,362,284 was done. This is 60% more than the high-

*Engineering News, Feb. 15, 1912, p. 281.

TABLE II

Miles	Contracts in Force Date	No.	Total Value of Work Under Contract	Total Value of Work Amount due	Per Cent	During Year
24	December 31, 1905	6	$4,242,620	$330,120	0.8	330,120
68	December 31, 1906	18	15,352,639	1,041,610	6.8	711,490
127	December 31, 1907	21	22,392,704	3,257,910	14.5	2,216,300
198	December 31, 1908	37	35,746,136	8,701,223	24.3	5,443,313
320	December 31, 1909	58	54,138,329	16,291,315	30.1	7,590,092
409	December 31, 1910	81	74,356,398	25,869,723	34.8	9,578,408
409	December 31, 1911	91	74,950,318	41,232,007	55.0	15,362,284

(First work, Champlain Canal, Fort Miller, April 24, 1905. First work, Erie Canal, Waterford, June 7, 1905.)

TABLE III

Miles	No. of Contracts	Name of Canal	Total Value of Work Put under Contract	Total Value of Work Done to June 1, 1912	Percentage of work done June 1, 1912
353	58	Erie	54,600,838	32,606,209	60
62	17	Champlain	10,889,204	7,963,535	73
23	12	Oswego	5,699,364	2,765,329	50
15	3	Cayuga and Seneca	1,999,873	697,460	35
	4	Water Supply	2,320,327	1,137,990	50
	2	Power Supply	225,303	177,900	80
Total	96	Total	$75,734,909	$45,348,423	60

TABLE IV

Kind of Work	Amount	Measure	Similar work grouped
Excavation....	62,774,015	cu.yd.	Earth and rock, grubbing
Embankment..	6,774,819	cu.yd.	Also puddle
Concrete.....	1,556,456	cu.yd.	Also grouted filling
Dry stone work	615,680	cu.yd.	Also wash walls
Sawed lumber..	12,824,310	Ft.B.M.	Sheet piling and bracing
Round timber.	664,606	Lin.ft.	
Foundation piles.....	868,099	No.	
Iron and steel..	32,496,357	Lbs.	Castings, pipe, reinforcement
Iron and steel..	$1,046,147	$	Lock gates, valves
Miscellaneous..	$515,923	$	Bailing and drawing
Miscellaneous..	$551,086	$	Channeling, sewers.
Extra work....	$413,844	$	

est yearly record heretofore, and is three-fifths of the amount of work that had been done in the six preceding years.

Table III shows the total value of work under contract and done to June 1, 1912, on the various canal sections:

Table IV shows the total amount of all kinds of construction work done to Jan. 1, 1912:

On June 1, 1912, there had been let 96 contracts; on the same date 22 of these were finished, of which 12 were on the Erie, 7 on the Champlain and 3 on the Oswego Canal. The final estimate was $8,656,273, between 11 and 12% of the work under contract.

No considerable stretch of the canal is finished. On the Erie Canal, dam No. 7 and lock No. 11, at Amsterdam, 42 miles from the Troy dam; and dam No. 8 and lock No. 12, at Tribes Hill, 46 miles from the same place, are finished, which is contract No. 17. Contract No. 18, comprising dam No. 12 and lock No. 16, 73 miles from the Troy dam, is complete. The next section is contract No. 4, some 5 miles of canal prism east of Sylvan Beach, Oneida Lake, and 124 to 129 from the Troy dam, is done. The Caughdenoy dam, in the Oneida River, and lock No. 24, at Baldwinsville, are finished, 173 miles from the Troy dam. Next is contract No. 5, on the Seneca River, about 200 miles from the Troy dam; contract No. 6, at Rochester, and contract No. 9, at Eagle Harbor, between Rochester and Lockport.

Roughly speaking, about one-half of the Erie Canal work is finished, although some sections have not yet been begun, notably contract No. 8A*, for constructing dam No. 4 and lock No. 8, at Scotia, on the Mohawk River, and contract No. 65, for work at Medina, including the crossing of Oak Orchard Creek. Unless extraordinary energy is displayed in the prosecution of these two important contracts, they will not be complete until one to two years after the remainder of the canal is ready for operation.

On the Champlain Canal, the work is farther advanced, being now 73% finished, while on the Oswego Canal 50% is done, and on the Cayuga and Seneca Canal, 35%.

No work has as yet been done at the Troy or No. 1 dam, some discussion having arisen who should build it, the United States government or New York State.

The estimated cost of the new Erie, Champlain and Oswego Canals was $101,000,000; that of the Cayuga and Seneca Canal, $7,000,000, a total of $108,000,000. Contracts let to date aggregate $76,000,000, so there remains $32,000,000 for work yet to be done, land damages, engineering and contingencies.

It is confidently believed that the entire canal can be built within the original appropriation.

In conclusion it may be stated that the official reports of the State Engineer and others have been largely drawn upon for the facts and figures given.

*This contract has just been let; see note at end of this article.

The Scotia Dam of the New York State Barge Canal, officially known as Dam No. 4 and Lock No. 8, and one of the numerous movable dams along the Mohawk River portion of the canal, will have foundations placed with pneumatic caissons. The bed rock at this point is 65 ft. below the level of the river, which is subject to rises of from 17 to 20 ft. several times in the year. In view of these facts it was thought impracticable to attempt to build the dam with the ordinary open cofferdam method, and the 726 ft. length is to be built in a line of 24 pneumatic caissons joined together after the method used in the final construction of the foundation of the Hauser Lake Dam in Montana, as described in Engineering News, June 22, 1911, p. 743. It is intended that these caissons shall be built of reinforced concrete. The contract has been awarded to The Foundation Co., of New York City, and is already under way.

Management of Tracklaying on New Railway Work*

In the discussion of the methods employed to obtain the best and most economical results with tracklaying on construction work, the committee has limited itself to the consideration of the following points: (1) Should the building of new yards and main lines (which are not let to contractors) be handled exclusively by the engineering departments? (2) Should such work be handled by the maintenance-of-way department? (3) Should such work be placed under the direct supervision of a practical track man?

In regard to the first point, the plans, specifications, etc., should be prepared by the chief engineer, but the actual supervision of the work should be in charge of a practical track man. There should, of course, be a resident engineer on the ground to lay out the work in accordance with the specifications.

The man in charge can best ascertain the proper kind of material to be selected and the manner in which it should be placed on the subgrade in order to eliminate the possibility of soft spots which so frequently develop in tracks under the pressure of heavy traffic and which form the most serious drawback in the maintenance of a first-class track in the future. He can also provide good drainage, sufficient ballast under the ties, and proper spacing and placing of ties in accordance with the size and condition of ties provided, all of which are essential to the construction of good, substantial tracks. The construction of all new track work or such tracks as come under the head of "construction work" should be completed in detail at the cost of construction before being turned over to the maintenance department.

As to the second point, such work should not be handled by the maintenance-of-way department, for the reason that the average roadmaster has as much maintenance supervision as can be properly looked after, particularly during the working season.

As to the third point, work of this character should be in charge of a practical track man, selected by the proper officials, together with a resident engineer.

A saving in cost and time can be obtained by the use of a tracklaying machine in laying the first track, depending largely (of course) on good organization. Second and other additional tracks can best be constructed by unloading the necessary material from the existing track; this applies also to yard tracks. All necessary grading can be done by train to very good advantage when the material is not at hand to be hauled by teams.

The advantage in making fills by train lies in the fact that better material can be obtained and used after the material is unloaded from the train with a side plow and leveled back to the full depth and width for an additional track. If gravel ballast is to be used it can also be unloaded and spread on the grade with a spreader to the width and height required before tracklaying, so that when the steel is laid there is no lifting to be done beyond surfacing or a light lift.

*Abstract of a committee report presented at the annual meeting of the Roadmasters and Maintenance-of-Way Association, Buffalo, N. Y., Sept. 10-13.

A Complete Automobile Route between New York City and the Pacific Coast has just been laid out by an official representative of the American Automobile Association, who left New York on July 11, and traveled by way of Buffalo, Chicago, Milwaukee, St. Paul, Minneapolis, Bismarck, Miles City, Billings, Livingston, Butte, Missoula and Spokane, reaching Seattle about Aug. 24. Incidental to fixing the main route, observations were made on the possibility of fixing a route connecting the Yellowstone and the Glacier National Parks, and such a route was laid out.

Defective Concrete Piles

In the construction of a building in New York City recently a serious defect was found in the concrete piles which were intended as supports for the column piers. This defect is illustrated by the sketches and views shown herewith. The accidental discovery of the defect and the resulting investigation by the inspectors of the Bureau of Buildings resulted in the rejection of the entire foundation and the decision to place ordinary spread footings.

The foundation consisted of groups of five to eight piles, each group forming the foundation for the concrete footing of one of the columns of the building. These piles were constructed by first driving down a metal form for the pile and then ramming in concrete to form an enlarged base, withdrawing the metal shell as the concrete fills up the shaft of the pile. After the foundation was completed by the sub-contractors it was necessary to excavate at one of the footings down to groundwater level, some 5 or 6 ft. below the tops of the piles. Near

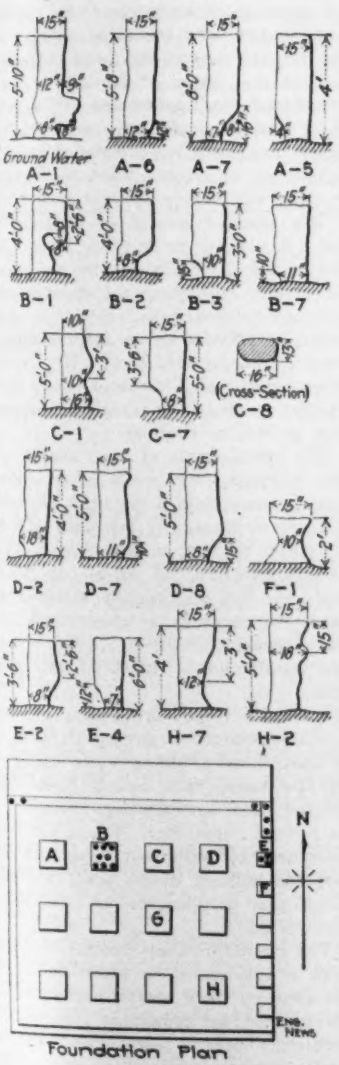
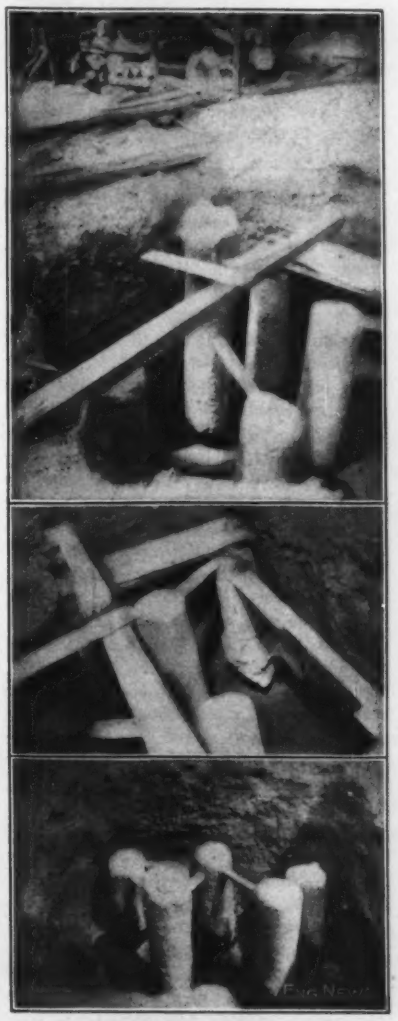


FIG. 1. SKETCHES OF DEFECTS IN UPPER PART OF CONCRETE FOUNDATION PILES IN A NEW YORK BUILDING FOUNDATION

(Note—Piles A2 and A3 were in such bad condition that they broke off while being excavated. Piles in group B other than the four shown were of regular form.)



FIGS. 2-4. THREE VIEWS OF DEFECTS IN CONCRETE PILES IN A NEW YORK BUILDING FOUNDATION

groundwater level a deep recess was found in the side of the pile exposed, reducing the cross-sectional area of the pile at this point considerably. The architect of the building then ordered the excavation of further piles, and the examination went on progressively until all the piles of the building had been examined in the manner indicated, that is to say, for the upper 6 or 7 ft. of their length. The group of sketches shown in Fig. 1 herewith is a collection representing the defective piles in the foundation. As may be seen from the plan sketch below, the foundation is only moderately large, and the number of defective piles represents a rather large proportion of the total.

After discovering the defective condition of the piles the contractors made a load test of one of the piles with a view to determining whether it was strong enough for the loading which would come upon it. The test does not appear to have been fully satisfactory; the ultimate result, however, was that the architect decided to reject the entire foundation, as already noted.

The explanation is offered for these defects that in driving one pile after others of the same group had been driven a displacement of the ground occurred at some particularly soft stratum, which forced the soil against the concrete of the piles already placed but not yet set hard, and distorted this concrete, forming the recesses and irregularities shown. If this is the true explanation it would be more or less a matter of guesswork whether in a given group of piles any of them contained this defect, and if so how extensive and numerous these defects are or where they are located. In the case in question the Bureau of Buildings decided that it would be necessary to submit each single pile of the entire foundation to a load test by building a platform over the pile and placing load upon it until a load approximately twice as great as the intended working load had been reached. If the piles showed that they could carry such load without appreciable settlement, the foundation would be approved in spite of the fact that the condition of the lower part of the piles was unknown.

We are indebted for the above information to R. P. Miller, Superintendent, Bureau of Buildings, Borough of Manhattan, New York City.

A Memorial to a pioneer Panama Canal promoter, Lieut. Lucien Napoleon Bonaparte Wyse, of the French Navy, has been placed on the seawall of the city of Panama by the municipal authorities and was officially unveiled on Aug. 12. The memorial is described in press dispatches as a statuette.

Lieut. . yse was sent to the Isthmus in 1876 by a society organized in France to explore the Central American territory for a canal route. Lieut. Wyse's name has always been more closely associated with the Acanti route from the Gulf of Darien to the Gulf of San Miguel than with the present Panama Canal route; but later he accepted the Chagres River route as the most feasible and was one of De Lesseps' right-hand men in promoting the first French company and obtaining concessions from the Central American governments.

The original Acanti scheme of Lieut. Wyse included a tunnel through the central mountain range, to be eight miles long and nearly 120 ft. high above the water line. The estimated cost of this canal in 1879 was "about $100,000,000."

Wells as Sources of Supplementary Water-Supplies

By Myron L. Fuller*

While all engineers realize that groundwaters, both shallow and artesian, may under certain conditions be of importance as sources of public water-supplies, the prevailing impression seems to be that the conditions under which such waters are to be obtained are somewhat exceptional that only occasionally is it practicable to place dependence upon them.

It is to be regretted that the extent to which groundwaters are available is so seldom recognized and that their importance as sources of supply are so rarely appreciated. In reality, the presence of groundwaters in economic quantities is far from rare. Such waters, using the term groundwater to include both shallow and deep-seated supplies, are found not only in sands, gravels and other porous surface deposits but also in sandstone, limestone, shales and slates, and even in the more dense and massive rocks, such as the granites and traps.

The amount of water in the soils and rocks is often much greater than is commonly supposed, as is indicated by the following figures:

POROSITY OF SOILS AND ROCKS

	Per cent.
Soil and loam	55
Clay	50
Sand	30
Chalk	50
Sandstone	10
Limestone and marble	4.5
Slate and shale	4.0
Granite and trap	1.0
Quartzite	0.5

The actual volume of water in the rocks will in most cases be in excess of the quantity indicated by the porosities, since considerable amounts also occur in the more or less open passages, such as joints, bedding planes or solution channels. On the other hand, it should be born in mind that the finer grained materials hold their water very tenaciously and by no means all of it is given up to wells.

As a matter of fact, however, few localities are so unfavorably situated that a well or series of wells properly located will not develop a supply of at least 100 gal. per min. This amount is substantially equivalent to 150,000 gal. per day, a quantity sufficient to supply 3000 people at a per capita consumption of 50 gal. per day or 6000 people at a per capita consumption of 25 gal.

It is not, however, on wells or groundwaters as the sole sources of supply of a town that we would dwell, but rather upon their utilization as supplementary supplies to eke out those from existing sources. While the towns that might be supplied entirely from wells may be counted by scores, those whose supplies might be supplemented to advantage by groundwaters may be numbered by hundreds. There is hardly a state that does not have within its limits dozens of villages or towns whose surface supplies are limited and inadequate to meet the requirements.

In some cases the surface supply will be fairly constant in quantity and nearly sufficient to meet the demands made upon it. A single well, in such instances, may be sufficient to supply the deficiency. At other times the regular supply will be subject to wide seasonal or other variations and may even fail entirely at times. It is in such instances that the problem becomes most serious. Perhaps the daily consumption of a town of 20,000 may be 1,000,000 gal., while the most that can be obtained from wells is 200,000 gal., or only a fifth of that consumed each day. At first glance the amount seems woefully inadequate and wholly incapable of affording relief. Fortunately, however, this is by no means always the case.

That wells yielding the quantity of water mentioned should supply the whole 20,000 inhabitants in case of failure of the regular supply is, of course, impossible, however much the people might retrench in their use of the water. The wells would even be unable to supply the deficiency in times of drought when the regular supply was reduced to perhaps a third of the amount actually consumed. Nevertheless, by a little forethought and by scientific utilization of the well supply not only will the situation often be greatly relieved but long periods of marked shortage may be successfully tided over.

For instance, let it be assumed that a town having the size and consumption mentioned (20,000 people using 1,000,000 gal. daily) has a reservoir holding a 60-days' supply or 60,000,000 gal., and that the inflow exceeds the consumption from Dec. 1 to June 1, while the deficiency between June 1 and Dec. 1 varies from 0 to a maximum of 700,000 gal. per day in August and September. Let us consider first what would happen if there were no supplementary supply available. This is indicated in Table I, in which figures are in million gallons.

TABLE I. CONDITIONS WITHOUT WELLS

30 days ending	Regular supply	Deficiency	Amount remaining in reservoir
May 31	30	0	60
June 30	24	6	54
July 30	18	12	42
Aug. 29	12	18	24
Sept. 28	12	18	6
Oct. 28	18	12	None
Nov. 27	24	6	None
Dec. 27	30	0	Begins to fill

It is seen that, in the absence of any supplementary supply, the reservoir would be emptied by the middle of October, and that for nearly two months the town would be without a reserve supply and dependent solely upon the daily inflow, which would be far below the demands.

The conditions with a supplementary supply from wells of only 200,000 gal. daily, or a fifth of the total consumption, is shown by Table II. This table brings out the fact that, notwithstanding the apparent insignificance of the groundwater supply and the large shortage in the regular supply, the town would go through the season of drought with undiminished consumption and with a minimum reserve equivalent to a 24-days' supply as against two months of absolute exhaustion of reserve when the supplementary well supply was not available.

TABLE II. CONDITIONS WITH WELLS

30 days ending	Regular supply	Well supply	Deficiency	Amount remaining in reservoir
May 31	30	6	0	60
June 30	24	6	0	60
July 30	18	6	6	54
Aug. 29	12	6	12	42
Sept. 28	12	6	12	30
Oct. 28	18	6	6	24
Nov. 27	24	6	0	24

The example quoted is hypothetical, but it is believed to be fairly representative of the conditions existing at numerous points throughout the country, and although complete relief will not, in many cases, be afforded by so small a supplementary supply, there will be, on the other hand, many instances where even smaller groundwater supplies will tide over periods of shortage.

The effectiveness of such supplementary supplies from wells is so evident that it seems strange that their possibilities are so frequently lost sight of. As a matter of fact, a few thousands of dollars expended in driven or drilled wells will not infrequently postpone for years the necessity of constructing new and expensive reservoirs, and, perhaps, the installation of miles of new pipe line.

It is at those localities where the available sources of surface supplies, or at least those affording water usable in its raw state, have already been fully utilized that groundwaters become of paramount importance. Often, their development by wells will make unnecessary the building of the costly filtration plants that would otherwise have to be constructed.

The possibilities of groundwater supplies should never be overlooked. On the contrary, they should be thoroughly investigated by competent groundwater specialists before costly extensions of surface systems are undertaken.

The utilization of wells as sources of supplementary supplies, however, requires judgment and forethought. A town should not wait until the reservoir is depleted or emptied before drawing upon the wells, but should begin pumping the minute the consumption exceeds the inflow.

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The Lake Front Park Extension in Chicago

The development of the lake front of Chicago, south of the Chicago River, for the public use and benefit, has for years been a problem and a subject of controversy. Until a few years ago the Illinois Central R.R. owned and occupied almost the entire lake front from the river to 50th St., and the public had practically no access to it. The location is an ideal site for a public park, within easy reach of the congested districts, and the first step toward remedying the conditions was taken when the construction of the present Grant park was made practicable. This was formed by filling in the submerged lands east of the railway, from the river south to Park Place (just north of 12th St.), directly opposite the business section of the city. The filling and subsequent landscape work have been going on several years, and are not yet completed. It covers about 200 acres.

The South Park Commission next took up the project of a lake-front boulevard and parkway connecting Grant Park (at Park Place) with Jackson Park (at 56th St.). Both parks are under the control of the Commission, and the parkway would be formed over land which is now submerged. The Illinois Central R.R. owned a part of the submerged lands and claimed ownership of the greater part of the land required, as well as of the riparian rights. To avoid protracted delays over litigation and special legislation to acquire possession of these lands, the Commission entered into negotiations with the railway company, and after much consideration and controversy an agreement was made (and confirmed by the Superior Court) establishing a boundary line for the east side of the railway right of way. Certain submerged areas on the west side of this boundary are retained by the company, which must fill and reclaim them. On the other hand, the company transfers to the Commission its title to lands east of this boundary line, with its riparian rights, thus giving the Commission a free hand in carrying out the development of a continuous lake-front park from Park Place to 50th St.

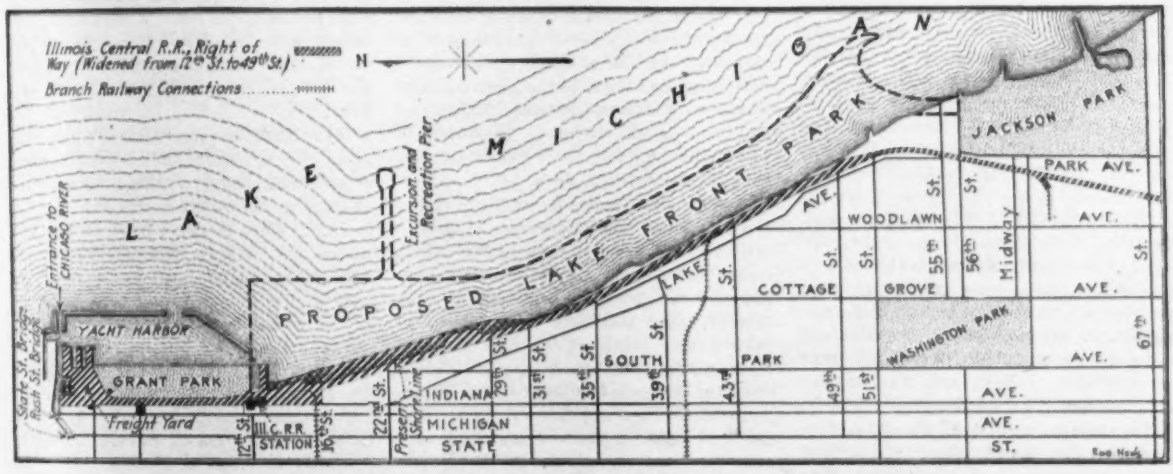
The width of this park from the railway to the new shore line will be approximately ¾ mile, while at 12th St. the new park will extend nearly a mile into the lake. It has been proposed also to widen Grant Park by filling in along the yacht harbor. Practically all of the extension will be on filled or reclaimed land. The details of the work have not been planned as yet, and the proposed limits are subject to the approval of the U. S. War Department in establishing the new shore line. The general character of the project is shown on the accompanying cut.

From the river to Park Place the railway tracks were depressed 16 years ago, and the width of right of way was permanently settled by contract made at that time. Since then concrete retaining walls have been built on the boundary line, to retain the filling for Grant Park. The boundary line under the new contract fixes the width of right of way from Park Place as far south as 49th St. This width, including the land already in actual use by the railway company, is 360 ft. at Park Place, 660 ft. at 18th St., and 560 ft. at 29th St.; it then reduces to 250 ft. at 31st St., and this width is maintained to 41st St., from which point to 49th St., a width of 300 ft. is maintained. In several places considerable areas of property now claimed and used by the railway company are outside of the boundary line, and become the property of the South Park Board.

Between 31st and 43d Sts., the tracks are to be depressed to an elevation of 4 ft. above Chicago datum, to facilitate the establishment of street bridges over the right of way. Thence, the tracks rise by grades of 0.3% to the present level at 29th and 47th Sts. South of a line 500 ft. north of 29th St. no buildings (except necessary suburban stations, signal towers, etc.) are to be erected and no advertising signs or other obstructions to the view established; nor is the right of way to be used as a yard or for storage of cars and equipment. It is provided, however, that (subject to permission of the city) buildings may be erected between 29th and 31st Sts. if the character of the district should change from residential (as at present) to industrial. On the submerged lands filled by the railway company trains are to be operated only by "motive power other than steam," but the agreement specifies no period for such operation.

The Park Commission may construct bridges or viaducts across the railway in line with the streets, so as to give ready access to the lake-front park. The bridge at 12th St. must not be built until the railway company has put in service the electric operation of its line and terminal; these bridges or viaducts will be paid for by the city. The bridges, however, must not interfere with the inclines connecting the Illinois Central R.R. with the overhead lines of the St. Charles Air Line (at 16th St.) and the Chicago Junction Ry. (at 41st St.). The city is given the right to lay sewers, pipes, etc., and one street subway beneath the tracks.

Important changes will be made at the present main line terminal station of the Illinois Central R.R., at Park Place, which now blocks 12th St. and Indiana Ave. The city will extend 12th St. (which is to be widened and made an important thoroughfare) from its present end at Indiana Ave. east to the new lake front; and Indiana Ave., which is now enclosed by railway property between 12th and



MAP SHOWING THE PROPOSED LAKE-FRONT PARK AT CHICAGO
(Outside of the Revised Right-of-Way of the Illinois Central R.R.)

13th Sts., will be widened from 16th St. and extended north to 12th St., thus creating a new north and south thoroughfare. The railway company agrees to remove its present terminal station and office building and build a new station on the south side of 12th St.

At the south end of Grant Park and east of the railway boundary line will be the new Field Museum, and the parkway extending thence to Jackson Park will comprise a boulevard, open spaces, lagoons, and other decorative features.

The Relation of Electrical Engineering to Other Professions*

By Gano Dunn†

On the wall of a great engineering library is the legend "Engineering is the art of organizing and directing men, and of controlling the forces and materials of Nature for the benefit of the human race," This is broad and all-embracing, but other professions will find it hard successfully to quarrel with it. It may be asked, Why could not a similar statement of embrasure or scope apply to medicine, the law, the army and other professions? In part it could, but it is to engineering that it applies preëminently.

While the immediate object of engineering is a material one, engineers draw from many different channels of human energy, such as generalship, commerce, psychology, mechanics, economics, to say nothing of chemistry and physics and many others, all under an interpretation, insight and method that are best described by the term scientific.

The subject matter of the older professions, the things about which they busy themselves, and the objects they seek to accomplish have changed relatively little in many centuries. The means have altered but the ends persist. They are approximately the same today as they have been throughout history and tradition.

With engineering it is different. There was no such profession a hundred and fifty years ago, and if I may a little anticipate my conclusion, there will be no such profession a hundred and fifty years hence in respect to a large part of what we now call "engineering."

Such as it is, engineering is embracing an ever-growing horizon, and is including more and more of the activities of civilization. When I say activities I refer to material ones and not to the whole of life itself. The human spirit is the greatest fact in the world, and art and literature that interpret it, the acts of our daily life and our personal relations that depend upon it, religion and the vast body of our social and political experience, that go to constitute life form, undoubtedly, a mass of activities, which are greater, in terms of consciousness, than the material activities which engineering can affect. In other words, the humanities which have been the same for ages can never be invaded by anything that merely rearranges our relations to the material world.

Whether it really is engineering to organize men, to predict the psychology of a fare-paying population, to win the endorsement of a labor union, to treble the yield of a farm by a microscope, all of which successes are called engineering, depends upon the definition that we finally adopt.

It is startling to study the variety and importance of the posts filled by engineers and to note the range of what they do. From the efficiency engineer presenting surprises in the output of a factory where the human factor is large, or the agricultural engineer working miracles with the soil that for ages farmers have struggled with, to the civil engineer establishing a kingdom and building the Panama Canal, we have instances in which the engineer is doing more and more of the world's work.

The "Encyclopedia Brittanica" names the middle of the eighteenth century—that is, 1750—as the time before which there were only engineers who constructed "engines" of war, and it adds that at about that time there began to arise a new class. Little did this new class realize the army it was leading down the industrial paths of time! Where there were only military engineers and the "new class" a hundred and fifty years ago, there are twenty-seven recognized varieties today. Without mentioning all, they range from civil through mechanical, electrical, mining, illuminating and chemical, to refrigerating, industrial, agricultural and aëronautical. There is even a magazine with the title "Human Engineering." A large and increasing part of the capacity of our colleges and universities is devoted to the education of engineers. The social status of the engineer has emerged from that of a mechanic to one nearly as high as that of the clergyman, the physician or the lawyer.

Relatively recently there has been going on simultaneously with all this, however hardly noticed, something else—a vast increase in so called engineering work by men who are not engineers, and at the same time a large drawing off into executive, administrative, industrial, commercial, civic, educational, financial and even legal callings, of men of engineering training.

That one is an engineer gives very little idea of what he actually does. It does not locate him in one of the twenty-seven recognized classes. It leaves it possible for the hearer to think of him as a "social engineer" or an "efficiency engineer" should he not look like a "civil engineer"; but even if he did define himself and say he was an electrical engineer, the hearer would still not know whether he represented the last word on the loading of telephone circuits or his responsibility was to determine whether the great railroad terminals of Chicago should use a third rail or an overhead catenary. If he should say "I am a teacher," "a physician," "a clergyman," "a lawyer," there would be a much more definite conception attaching to his answer. There must be, therefore, in the title "engineer" something broader, something not included, or included to a lesser degree, in the titles of the other professions or occupations. A light is shed if we examine a popular definition that engineering is "educated common sense."

Can it be that unlike "physician," "lawyer," "teacher," the term "engineer" does not describe what a man *does*, but rather *how* he does it! A method rather than an occupation! It is even so; that is, essentially and with limitations.

What then is this "method" that has given the engineer his ever broadening domain and brought all kinds of men and callings to his school? He can tell you at once. Here is where he is defined and where his fellows recognize him and each other though they come from the ends of the industrial earth as to diversity of actual occupation.

The method had its birth in Greece, though it was stifled almost to death by the tremendous philosophic, humanistic and artistic energies of the Hellenes. Later it was buried in Europe under the irruption of the barbarians. But the Greeks made only a start. To quote an authority, their material thinking was largely based on what has proved to be a wrong method of procedure, the introspective and conjectural rather than the inductive and experimental. They investigated Nature by studying their own minds, by considering the meanings of words, rather than by studying things and recording phenomena. But they saw much of the light with all this.

Though absolutely dead for a thousand years in Europe, "the method" was kept alive during the middle ages in Arabia, although confused with magic, alchemy and algebra. Then came Roger Bacon, Leonardo da Vinci and Copernicus, and science as we know it began to take shape. Aristotle had sat down in his chamber and he wrote in a book, "A body twice as heavy as another of course falls twice as fast." Galileo released simultaneously from the top of the Leaning Tower a 1-lb. and a 100-lb. shot, and they reached the earth together, before the eyes of the assembled University of

*Presidential Address: Annual Convention of the American Institute of Electrical Engineers, Boston, Mass., June 25, 1912. Copyright, 1912, by the American Institute of Electrical Engineers.

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Pisa. But "the method" was repugnant to the university, and almost to a man they believed their Aristotle, sophistically explained away what they saw, and persecuted Galileo. Descartes, Newton, Lagrange, Laplace, Francis Bacon connote to engineers the transcendent story, unless for electrical engineers there should be added Ampere, Faraday, Henry, Helmholtz, Kelvin.

The method of doing things that makes an engineer is, therefore, the applying to practical and utilitarian ends the principles and reasoning of science. Engineering is not science, for in science there is no place for the conception of utility. Truth is her sole criterion. Engineering is science's handmaid following after her in honor and affection, but doing the practical chores of life, concerned with the useful and the material, cut to, with costs and with expediency, and concerned with the humanities only in so far as they are an incident in some particular scheme of reality, and then objectivity, if that may be said. Her methods merely apply straight thinking to material problems for useful purposes.

Does this constitute a profession? No. Some day it will be the way almost everybody thinks instead of a body of specialists and then the difference between a doctor, for instance, and an engineer will be only in the things they busy themselves about; as is today the only difference between kinds of engineers.

Now, as to the limits within which engineering is a method rather than an occupation. There will always be engineers, for the methods of science will constantly advance, and there will be needed continually, to interpret and transmit them to mankind, and to make the first applications of them to useful purposes, a class of men who, by instinct and taste, as well as by the possession of what I later shall call the dynamic component, find easier than other men—and consequently perform better—the kind of scientific thinking, observation and action that characterize engineers today.

What these men will be busy about it is hardly safe to say, although it is probable the present great divisions of engineering will be more or less preserved. It seems certain that a large mass of knowledge that now is called engineering and forms the basis of many of the engineering specializations, will become general knowledge, and will be absorbed by the community, partly as a result of the shifting of the center of education and partly through everyday familiarity, and the men possessing this knowledge will no longer be called engineers. They will be called farmers, let us say, in the case of the "agricultural engineers"—but, of course, a farmer of a very advanced kind compared to the earlier one.

But the center of education will not always continue to shift. It is shifting now only because it has so long been eccentric. It would be a calamity for it to shift too far, resulting in a world whose sole training was applied science and the utilities. Under such a condition, engineering and the utilities themselves would languish instead of flourishing, for there would be lacking in engineers the dynamic component. Ample knowledge, insight, information does not make an engineer. He must first be a man. Engineering is not thought like philosophy; it is thought times action, and only when the qualities of action are developed approximately to the same extent as the qualities of thought is an engineer at his best. Only then is his area of effect a maximum. The qualities of action involve tastes and personality, the feelings, the will. And it is these that constitute the component or factor that makes an engineer's inellectual or rationalizing equipment dynamic—that puts it to use.

It was partly the intense appreciation of the value of the dynamic component that led the Greeks and successive centuries astray in the direction of their education and contributed to an underestimate of the importance of science and the study of the laws of nature. We must not go to the equally wrong other extreme.

So far I have said but little of electrical engineering. It must be brought in if for no other purpose than to justify our title. Although the article on "Engineering" in the "Brittanica" occupies only 6 in. of one column, it concludes with the following: "The last great new branch is *electrical* engineering, which touches the older branches at so many points that it has been said that all engineers must be electricians."

If engineering is a method of doing things, and electrical engineering tends to embrace all other branches, there is an implication that electrical engineering is the latest or most highly developed form of the method—the method that is the utilitarian applicaion of the principles of science to the material facts of life.

Such is unquestionably the case. Born scarcely more than twenty-five years ago, the "youngest branch," electrical engineering had the opportunity of striking its roots into the richest scientific soils, free from prejudices, customs or traditions. It had no entangling alliances, no political laws to retard or encumber it. The field it preëmpted was the Terra Nova of Engineering, the New World of Applied Science.

Under the influence of those geniuses of science, Volta, Faraday, Ampere, Ohm, Kelvin, Helmholtz, Maxwell, Oersted, Henry, and with the metric system for its corner stone, there developed a comprehensive structure of thought and a related scheme of units. The latter are the admiration of the world for their simplicity, their convenience, their precision and their reproducibility. The scientific method as applying to all phenomena acquired its most perfect embodiment in the electric system and its relations.

Aside from all this, there is a philosophic debt that we electrical engineers owe our units. They school our minds. The ability to measure with precision difficult and complicated quantities enables clear thinking on them and renders reasoning about them possible that otherwise could not be attempted. The wonderful electrical units are a fluent language that gives the widest opportunity to thought. By their character they educate our faculties of definition and of relation.

That which can impose form upon our thought enables us successfully to think of any kind of thing. The forms of thought established for electrical engineering are at once so comprehensive, so rigid, so rich in detail, and so illuminating that engineering does not bound them. They may be called the manifestation of science in civilization, the best representation of the scientific method at work for utilitarian ends. They prove that the profession of electrical engineering not only deals with single-phase motors, storage batteries, high-tension transmissions, turbo generators, coronas, carbon transmitters and commutation, *as an occupation*, but that it also is a *way of thinking*, and as such is not an occupation, but the latest and most highly developed scientific method of solving all kinds of practical problems of matter and force, for the benefit of the human race.

The Engineering Work in connection with the Panama-Pacific International Exposition at San Francisco, Calif., is proceeding rapidly. The department of civil engineering is organized under E. E. Carpenter, of Sanderson & Porter, of New York and San Francisco, as Chief Engineer. The department of civil engineering is subdivided into divisions on sewerage, water supply, fire-protection system, wharf construction, boring for foundation tests, and dredging. There is a separate department of construction which has charge of the preparation of plans and specifications and the supervision of construction of all the buildings to be erected. A department of mechanical and electrical engineering is at present engaged in studies for the underground distribution system and wiring systems of buildings for electric power. Careful detail estimates of the amount of power required for a great variety of purposes are necessary. The department of architecture has completed a general block plan of the exposition grounds on a scale of 200 ft. = 1 in., and a larger plan to show more detail on a scale twice as large is now being prepared. Studies are being made for the selection of designs for the service buildings and for sites of other buildings. Besides these there are departments of sculpture, color and decoration and landscape gardening.

Harbor Cranes at Foreign Ports

A notable point of difference between American and foreign ports is in the crane equipment for loading and unloading cargo, this equipment being very limited in the former case, but very extensive in the latter. Such equipment as is in use at American ports is very generally installed by the railways or steamship companies and not by the port authorities.

With the very general use of cranes at foreign ports there has been considerable development of types to suit different kinds of work and different arrangements of quays, tracks and sheds. A very common type is the traveling pedestal crane, having the machinery contained in a tower, which is mounted on wheels (running along a track parallel with the quay or dock wall) and upon which is the revolving mast carrying the boom. The reach is varied by topping or luffing the boom. In many cases such machines are operated by hydraulic power. An objection to the pedestal cranes is the obstruction to movements on the quay, especially where three or four cranes are serving one vessel. This objection is avoided by the portal crane, in which the tower is in the form of a gantry traveling on a broad gage track so that it forms very little obstruction. A standard-gage track may be laid inside the crane track so that cars can be moved along the quay independent of the position or movements of the crane.

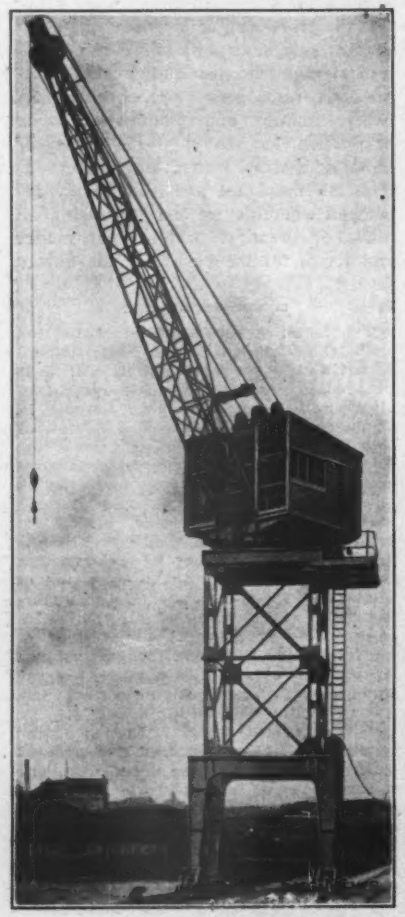


FIG. 2. ELECTRIC PORTAL CRANE WITH TALL TOWER; AUCKLAND, NEW ZEALAND

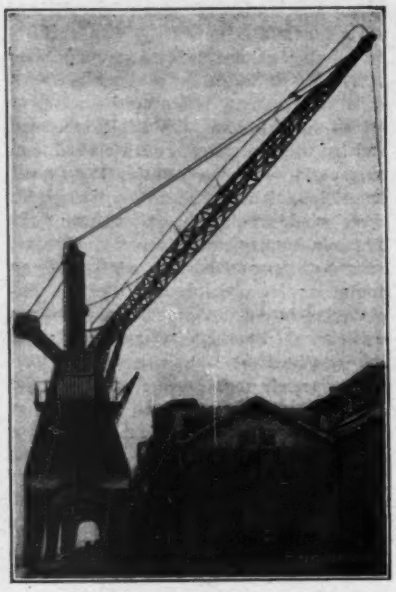


FIG. 1. HYDRAULIC PORTAL CRANES AT THE SURREY COMMERCIAL DOCKS; LONDON (ENGLAND)

Fig. 1 shows one of a row of 1-ton hydraulic traveling portal cranes at the Surrey Commercial Docks, London, England. These cranes were built by the East Ferry Road Engineering Works Co., of London. Fig. 2 shows a much higher crane of this type, with sufficient height and reach to extend over the pier shed and serve cars on a track on the opposite side. This is one of a number of 5-ton two-motor electric cranes built by Babcock & Wilcox, of London, for the Harbor Board of Auckland, New Zealand. The lower tower is 36 ft. high, and the maximum radius of the boom is 45 ft. The speeds are as follows: Hoisting, 5 tons at 120 ft. per min.; and 2½ tons at 230 ft.; topping (with load), 100 ft. horizontal per min.; swinging, 300 ft. per min. at head of boom. A further simplification is the semi-portal crane, which has but one gantry leg (near the side of the quay), the inner end of the bridge girder being fitted with a trolley which rides on a runway along the wall or roof of the pier shed. Fig. 3 shows a crane of this type at Auckland, having the same power and speed as that shown in Fig. 2.

The high-speed high-power electric cranes of the Babcock & Wilcox make are fitted with a special gear to insure economy in current consumption. With the ordinary equipment and controller, a great excess of power is required in starting the load, this being sometimes double the power required in hoisting. With the Crypto gear the motor is started light and attains full speed before the load is applied, with the result that the excess power in starting is only 10% greater than that for hoisting. According to the makers' statement a compound-wound motor is used instead of the usual series motor (when direct current is available); this is started without the load and is allowed to run continuously. The motor is geared to the first motion shaft by spur gear, and from the first motion shaft to the drum by a form of sun-and-planet gear, consisting of a pinion keyed to the first motion shaft gearing into idle pinions carried on a brake wheel free to revolve on the shaft. The idle pinions mesh with an internal spur rack, which is part of the hoisting drum.

When the motor is started the first-motion shaft revolves, driving the pinion keyed upon it, which in turn operates the idle pinions; the disk carrying them also revolves, and the drum remains stationary. A brake strap is fitted to the wheel carrying the idle pinions, and when this is applied, the wheel stops, and the drum commences to revolve. The load is started slowly and without shock by applying the brake, the speed of acceleration being regulated by the pressure applied to the brake; or it can even be lowered if necessary by means of this same

FIG. 3. SEMI-PORTAL ELECTRIC CARGO-HANDLING CRANE; AUCKLAND, NEW ZEALAND

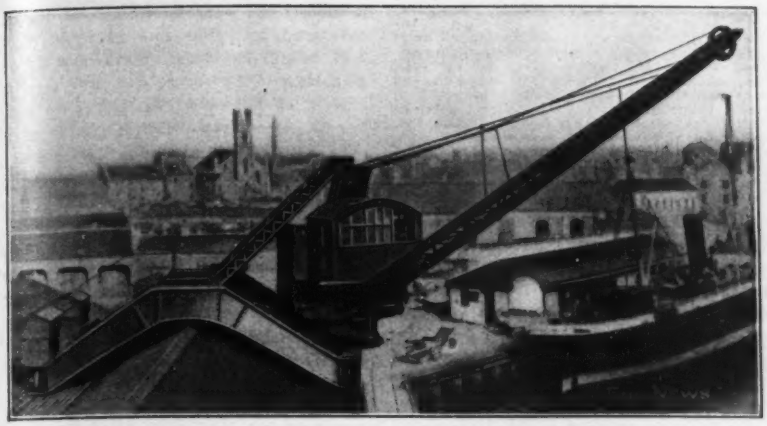


FIG. 4. ELECTRIC CRANE TRAVELING ON ROOF OF PIER SHED, ABERDEEN, SCOTLAND

brake, while the motor is running continuously in one direction.

Perhaps the most modern arrangement is to put the crane on the roof of the pier shed or warehouse, so that the pier is left entirely unobstructed. Fig. 4 shows one of several 2-ton electric cranes of this type at Aberdeen, Scotland, these also having been built by Babcock & Wilcox. Another device is the transporter crane, which may be operated from a gantry upon the quay or from the floor or roof of a pier shed or warehouse. The gantry in the former case, or a traveling frame in the latter case, carries a trolley forming the heel of a horizontal cantilever boom, which can be run to and fro (at right angles to the quay wall) and can be revolved in a horizontal plane. On this boom rides the hoisting trolley. Fig. 5 shows a machine of this type, built by Ransomes & Rapier, of Ipswich (England). It travels on a track of 30-ft. gage on the roof of a warehouse, and is used to unload sugar (in bags) from vessels 100 ft. below. In this case, however, the boom has no travel relatively to its gantry or carrying frame, but has only a revolving motion upon the gantry. This machine handles loads of 2¼ tons and has a maximum reach of 82 ft. The speeds are as follows: Hoisting, 250 ft. per min.; trolley travel, 250 ft.; gantry travel, 30 ft.; swinging, ⅛ revolution (72°) per minute. A somewhat similar but lighter machine, used at Montreal, was described in our issue of Nov. 9, 1911. This was built by Stothert & Pitt, of Bath, England. In the same issue there was a comparison of European and American methods of handling ships' cargo.

The equipment of two modern English ports may be mentioned by way of example. The docks at Manchester have about 90 electric and 55 hydraulic cranes of 1 to 10 tons hoisting capacity. Several of the electric cranes travel on the flat roofs of five-story freight sheds on the piers or quays; there are cranes on both sides of the roof, the large area of which is utilized for storage. Other electric cranes are installed in the sheds. The hydraulic cranes travel on tracks laid along the quays or piers. The new dock at Immingham (opened for use a few months ago) has 14 cargo-handling hydraulic portal cranes of 60-ft. lift; two can hoist 10 tons at 120 ft. per minute, and the others can hoist 2 tons at 300 ft. The working radius is from a minimum of 20 ft. to a maximum of 50 ft. These cranes travel on tracks of 13½-ft. gage, and have the bridge girder 14 ft. above the rails. There are also a number of hydraulic capstans for use in moving cars along the tracks on the quays and in the sheds. A pier used specially for the pig-iron trade has ten hydraulic cranes of the semi-portal type, one end of the bridge girder being carried on a runway like that for a traveling crane, the object being to minimize the obstruction to the yard tracks. These are of 3 and 5 tons capacity, hoisting at speeds of 180 ft. and 300 ft., respectively. The lumber yard and slip are served by five 1½-ton steam locomotive cranes. As there is a very large coal traffic this dock is equipped with a number of coaling machines of the car-dumping type, but this is special equipment, quite apart from that employed in handling cargo.

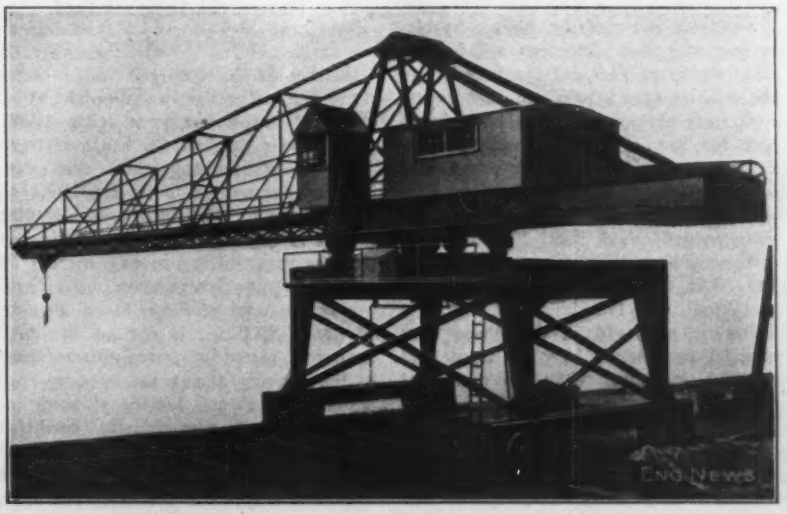


FIG. 5. ELECTRIC TRANSPORTER CRANE TRAVELING ON THE ROOF OF A WAREHOUSE AND UNLOADING CARGO FROM VESSELS

The Relation between Precipitation and Stream Flow; Ohio River Observations Covering 50 Years*

Complete precipitation records for the 50 years, 1861 to 1910 inclusive, have been obtained at Cincinnati, Marietta and Portsmouth, Ohio. At Lexington, Ky., the records extend from 1861 to 1876, and from 1887 to 1910, all inclusive, while from 1882 to 1886, inclusive, the records at Frankfort, Ky., were used. The record at Pittsburgh, Penn., extends from 1861 to 1863, and from 1872 to 1910, inclusive, while from 1867 to 1871, inclusive, data from Canonsburg, Penn., were used. The data at Westerville Ohio, were complete from 1861 to 1901, inclusive, while from 1902 to 1910, inclusive, those for the Ohio State University were used. In the place of North Lewisburg, Ohio, the data for Urbana, Ohio, were used for the years 1909 and 1910. In each instance where data from two stations were used, the places were not far apart, and there was probably no difference in the precipitation.

Unfortunately there are no stations with long records in West Virginia, or at other points south of the Ohio River, and it is probable that the means obtained

*From Bulletin No. 40, U. S. Weather Bureau, by J. Warren Smith, Professor of Meteorology.

from the seven stations used do not always give the true average precipitation for the Ohio watershed above Cincinnati. It was thought better, however, to use the same stations running through the 50-year period than to consider data from other sources.

For the stream-flow data, instead of considering the average height of the water, the total number of days in each month when the river was between each 10 ft. stage has been tabulated. Inasmuch as navigation is satisfactory in the Ohio when the river at Cincinnati is between 10 and 40 ft., those days when the river was below 10 ft. are considered low-water days, and above 40 ft., high-water days. The flood stage at Cincinnati is 50 ft., but there is more or less trouble navigating the river when it is above the 40-ft. stage because of strong currents, swirls, débris, and in its season, ice.

Prof. Smith comes to the following conclusions, which he regards as proven beyond dispute:

(1) River stages at Cincinnati depend upon the precipitation over the whole watershed above that city.

(2) There has been a very slight decrease in flood days in recent years, with the same rainfall.

(3) The same amount of rainfall causes a better flow of water in the river during the low-water period than formerly. The number of low-water days was 14% less during the past 25 years than during the preceding 25, calculating for the same rainfall. During the 10 years ending with 1910 the tendency for low water, with an equivalent rainfall, was not so great as for any preceding 10-year period for the past 50 years.

(4) Floods do not occur at Cincinnati during February and March unless the precipitation for these months is in excess of the normal, except on very rare occasions. The number of flood days increases most rapidly when the precipitation during these months is about 3 in. above the normal, or about one-half more than the normal.

Prof. Smith holds that, if it is true that the cutting away of the forests has increased the flood conditions and intensified low-water periods, a tabulation of the total number of days in each month with river readings between 10-ft. intervals for 10-year periods would show a regular increase in the low-water days in the months of July, August and September. On the contrary, however, there were only 64 days from 1901 to 1910, inclusive, when the river was between 5 and 10 ft. during the month of July, as compared with 179 days from 1861 to 1870, inclusive. In October there were only 96 days in the 10 years from 1901 to 1910, inclusive, when the river was below 5 ft., as compared with 177 days in the 10 years from 1871 to 1880, inclusive. The high-water days should show a regular increase also during the months from January to April, inclusive, but such is not the case.

Prof. Smith says:

Flood conditions are not the products of precipitation extending over any considerable period of time, but are, as a rule, the results of abnormal precipitation within a comparatively short time, and there is therfore no direct relation between the average annual precipitation and the number of flood days and the intensity of flood conditions. On the other hand, low-water periods are usually the results of prolonged periods of deficient precipitation, and the relation between the two is therefore quite clearly marked.

The correlation coefficient, obtained from the correlation between precipitation in February and March and the number of days that the river was above 40 ft., at Cincinnati for the

25 years from 1861 to 1885, inclusive, is 0.805, and for the 25 years from 1886 to 1910, inclusive, is 0.804, a difference much less than the probable error. This means that the tendency to cause the water to rise above 40 ft. by the same precipitation has been no greater during the last 25 years than during the preceding 25 years, or at least by a value too small to be calculated by the most approved method of correlation.

The correlation coefficient for precipitation and days when the river was above 50 ft. in February and March, for each of the 25-year periods, shows that the tendency to produce flood days with the same rainfall is slightly less during the last 25 years than during the preceding, although by a value too small to be considered, being about 0.3%.

Improving Street Traffic Conditions in Newark, N. J.

By F. Van Z. Lane*

The City Planning Commission of Newark, N. J., recently retained G. B. Ford, of Columbia University, and E. P. Goodrich, Consulting Engineer for the Borough of Manhattan, New York City, to make a "survey" of Newark. Among the most pressing problems was the traffic congestion at the corner of Market and Broad Sts. Study of this was made by the writer with the aid of a force of inspectors. The following notes and accompanying map are taken from his report to Messrs. Goodrich and Ford.

Immediate Needs

Market St. is, and will be for some time, the only highway through which east- and west-bound street-railroad traffic can pass through the heart of Newark. Under present methods this street is now operated up to its capacity, and the capacity of all thoroughfares leading into it is dependent on its capacity, so that the situation is serious. Market St. from the Pennsylvania Loop to the dividing switch west of Plain St., a distance of about 3100 ft., is one of the most congested pieces of street-railway track in the country during the evening rush hours. For actual density of traffic or number of cars operated, this condition should not exist. During the period of worst congestion, a rate of 180 cars per hour, and a speed of 3.9 miles per hour, is maintained west bound on Market St. compared with 168 cars at a speed of 6.27 miles per hour north bound on Broadway, New York, and 256 cars at 3.68 miles per hour east bound on Fulton St., Brooklyn. Heavy equipment is used on all three streets named and the type of cars and character of streets in Brooklyn are not as favorable as in Newark.

The capacity of Market St., and of the lines feeding into it, is limited by the number of cars that can be operated past the junction of Market and Broad, the slowest point on the line. Capacity is necessarily limited by (1) the long stops necessary to let Broad St. traffic pass, (2) the turning of cars into and out of Broad St. here, (3) the turning of vehicular traffic in all directions.

Further, the operation on Market St. is not up to full possible capacity even for the necessary adverse conditions, for the following reasons—all of which can be eliminated without discrimination, additional cost, or delay: (1) too many stops, (2) too lax loading, (3) too many turns out and in, (4) too much space wasted between cars, (5) no snap or team work to the operation. Because of all of these causes Market St. cars are many times not ready to move when the signal is given and if the first or second or any car in the waiting line is not ready it holds back others which may be ready.

On account of the width of Market St. and the heavy travel, the length of interval necessary to accomplish passing across Market on Broad is so long that Market St. cars must proceed in groups in order to make any way at all. If these cars cannot move in trains large enough to clear up the main line at each movement, the delay becomes cumulative for those that do not move.

The lack of snap and team operation is seen when a car comes leisurely along to the stop for this crossing and at a considerable distance behind its leader when the leader is already waiting for the crossing. The car in question finally closes up and takes on about half its waiting passengers when signal is given for the line to move. This car is then in no position to move and blocks any cars behind which may have been operating properly and are ready to move. The slow car must now move up and stop again before it can take the crossing on the next signal. If this car had been on the jump in the first place, proceeding as fast and as close to its leader as safety would permit, it would have been in proper position at all times.

Sometimes, however, because of vehicular interference, mechanical trouble, or other cause beyond control of a crew, a car may lose its place in the line and fall behind. In cases like this, a crew and inspectors should use judgment, foresight, and coöperation—anticipating the signal enough to stop loading and be prepared

*Traffic Engineer, Department of Public Works, Manhattan, New York City.

to start even though most of the load is left behind. Such a situation is one in which individual passengers or cars must be sacrificed for the benefit of thousands of other passengers and hundreds of other cars.

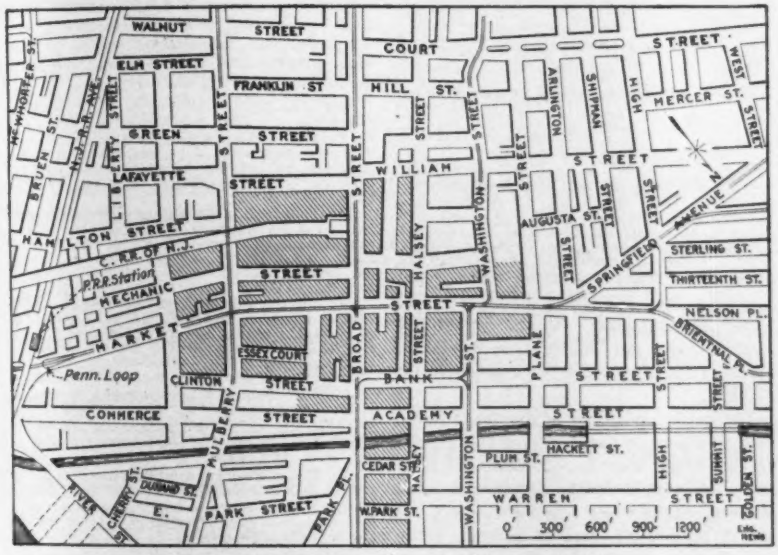
It was simply by these coöperative methods that trolley operation on Brooklyn Bridge was increased from 240 cars between 5 and 6 p.m. daily to 360 cars, and the running time also cut in half, notwithstanding the fact that these cars had to operate on a very heavily congested vehicle roadway and up and down long grades.

To cross Broad St. in large enough groups to work Market St. to its full capacity, cars must approach Broad St. in groups and so unload and load as to be prepared to move all at once. There is no reason, from passenger or traffic standpoint, why these Market St. cars cannot run by all streets between the Pennsylvania loop and the Plain St. dividing switch except Mulberry, Broad and Washington. These are the only streets in this section where cross traffic is heavy enough to interfere with the progress of a car. Any one of these points is within easy walking time and distance of every point within the congested limit.

The average time at present allowed each Market St. car to occupy the Broad St. crossing is 39.3 sec.; four cars of the type used can be safely taken across at six miles per hour in this time, and many observations have shown five cars crossing. The average combined load on the east and west sides of this crossing is 22 persons, and the average loading time is 1½ sec., so that the actual loading per car could be done in 33 sec. A minute would be sufficient time for cars to stop, load and get away from Broad St. with a margin of 27 sec. for slowing down and accelerating without effect on any following cars under one minute headway. The average loading and not the maximum is the one to be considered since this is a matter of regulation. By stopping only at the points noted and crossing as suggested, together with the further regulations noted, Market St. could be operated in trains of four detached units each under a minute's headway. The total operation would then approach 240 cars per hour or better at increased speed. This number is to be compared with the 180 cars observed.

Double stops at Broad and Washington Sts. could profitably be eliminated. Special effort has been made by the railroad company, by the use of an elaborate signal system, to make the west or far side of Broad St. the loading point for west bound Market St. cars, but as many, if not more, people still board these cars on the east or near side in order to stand a better chance of securing one of the rare seats. If the loading was confined to the west side only, time would be saved in the aggregate to the people from loading conditions alone because they would know absolutely in advance where their particular car would stop. As it is now, on the east side they do not know the exact stopping point and run to meet a car and, more times than not, on reaching it the car starts up again, leaving a string of people trailing after it, some of whom finally manage to board on the west side. This ludicrous sight is repeated nightly on Market St.

There is a further slow movement of all cars across the Broad St. crossing, due to the turning off of the Bloomfield and Paterson cars north on Broad and of the Central and Kinney cars on Washington St. Observations show that the average time used by these west-bound cars turning north into Broad St. from the point of switch at the beginning of the curve to the point where the rear of the car clears the main line of the west-bound track is 12 sec., whereas cars operating straight across consume but 8 sec. in clearing the same point. Thus every car continuing west on Market St. is delayed at least 4 sec. due to this turn-out of a Bloomfield or Paterson car. A total of 286 cars operated at this point between 5 and 7 p.m. showed 38 turning out. Every through car has to operate carefully and slowly past each of these junctions, for the motorman must wait for the switch to be set for him. They are all "facing-point" switches that can be "split" by the car, resulting in bad derailments. The delay of 4 sec. is not cumulative except for bunched cars and any cumulative tendency is offset by the absence of turning-off cars from many of the strings which take the crossing. The average probable delay then is 4 sec. for each of the 248 cars crossing—which means a total car loss of 16½ min. in these two hours and a passenger loss of 11 hours considering seated capacity alone.



MAP OF BUSINESS CENTER OF NEWARK, N. J.

(Shaded area indicates the "congested-value" business district as determined by the National Board of Fire Underwriters.—Ed.)

In the 51 Bloomfield, Paterson, Central and Kinney cars (the last two turning into and out of Washington St.), seen from 5 to 6 p.m. on a typical evening, were 828 passengers. Of these, 179 had transferred from other lines that came close to Bank and Washington Sts. These 828 people came from considerable distances and could have been carried in 20 cars. By routing off the Paterson, Bloomfield, Central and Kinney cars, and by putting up to 51 cars more per hour into the other Market St. lines, the street traffic would not be increased and the relief for Market St. travelers would be material, while the passengers on the four lines noted would not have been appreciably inconvenienced. There would be no delay in transfers since this movement would be accommodated at regular stopping places and periods.

Observations showed that 6391 vehicles other than cars used these four corners in the 10 hours from 8 a.m. to 6 p.m.; 74% make direct crossings, 17% make near or right-hand turns and 9% make far or left-hand turns. Inasmuch as so small a percentage makes obstructing turns and as parallel streets exist on all sides, these turns should be prohibited. This would not only greatly facilitate car movement, but would help vehicles and pedestrians as well. Pedestrians should be held on the sidewalk until all traffic going in their direction has the right-of-way. It is only due to the excellent manner in which this intersection is handled under present handicaps that serious accidents are not the order.

Market St. is so wide that there is no necessity whatever for vehicles to use

the track area of the street. Frequently vehicles are forced into this area because some other vehicle is standing too far from the curb, whereas if it had been close up, the passing vehicle could have proceeded without interfering with the cars. Of the vehicles observed on one railroad street in one day, 66% were from 1 to 3 ft. away from the curb and many had stood so for hours. Vehicles should be prohibited from standing at curbs at busy streets unless actually engaged in loading or unloading, and even this process should be stopped during rush hours. These points can be readily covered by an ordinance and the necessary rules enforced by the police.

No one is to be criticized for the conditions which exist, certainly not the railroad company, which is responsible only for cars which "drag the road" and make poor stops. The railway equipment is up to date, and is maintained and operated over good track and under good overhead work.

The general lack of snap can be readily explained by the attitude of the whole public which seems to be to keep Newark in some respects like a country town. This is shown too well by the fact that they require nearly 75% of the total number of cars operated in the city to go past the "Four Corners." How they get there, and what becomes of them after they get there, does not concern those interested.

The suggestions made can be carried out without expenditure and at once, except in removing the Bloomfield and Paterson cars (which turn into and out of Broad St., north) from Market St. The franchises of these two lines provide for operation to the Pennsylvania station, but the gain of removal would be so great in increasing the capacity of Market St. and the loss so small to the few who would have to transfer that the franchises should be modified.*

Future Needs

Figures have been obtained which show the rapid growth of passenger and car traffic on Market St. and that this is bound to continue. Even in June, when this study was made (the lightest time of the year on account of fair weather, reduced working forces, shorter hours, etc.), the average rush-hour load is nearly up to the ultimate car capacity. While increased capacity for present needs can immediately be secured as noted, nevertheless, permanent relief for future growth should be started through other channels.

The first practical way for this is by the use of a parallel street south of Market. Most of the railroad, vehicular and pedestrial traffic reaching Market St. comes from the southwest. William St. is the first to the south of Market paralleling it from the intersection with Springfield Ave. It is the logical street to improve and make ready for increased street traffic. It needs widening, straightening, and regrading to be of utmost value. This would distribute business more equitably and the values which would be raised throughout the south Broad St. section by stimulating business in that vicinity would more than pay for the improvements, which would present no serious engineering problems. South Orange and Springfield cars could then be operated through this street clear to their present terminals in the eastern section of the city, while Plank Road and Orange cars would continue to operate through Market St., which is their natural route. A loop could be made on William St., Treat Place, Branford Place and Washington St. by which some cars could loop right in the center of the city within a very few feet of Broad and Market Sts. without crossing or running on to either. William St. is far enough away from Market to build up its own business and yet close enough to be within easy distance. A relief street any nearer would not relieve the congestion since business would still concentrate on Market St.

The great advantage of the Treat Place loop is shown in the fact that today 2500 people board west-bound South Orange and Springfield cars at Broad and Market Sts. between 5 and 6:30 p.m. It would require 61 cars to provide them with seats, or 32 cars to carry them under present crowded conditions. This crowd and these cars would be taken off Market St.

Market St. can be materially relieved and improved by straightening the Washington St. intersection. At present all Washington St. vehicles crossing Market St. have to go on Market St. for about 95 ft., congesting the street at this point. If Washington St. were straightened by extending it practically in line with its course north of Market St. it would be wide enough on the south side for a loop which could be used by cars from a southerly section of the city. A building with a number of stories could be erected over the loop and could be used for municipal purposes or rented out. The desirability of such a building has been proved in other cities. Washington St. straightened would be available for crosstown lines. With these two improvements, Newark would have three excellent railroad terminals in the center of the city available for use without the crossing of main lines: the Bank St. loop, the Washington St. loop and the Treat Place loop, for cars from the north, south and west, respectively.

It may be argued that a subway under Market St. is the proper relief measure. It, however, would add to the surface congestion by concentrating business in one street. Cars have to be gotten into and out of subways, and this is impracticable on Market St. Subways are best available where vehicular conditions make car movement slow and where there are many crossings, neither of which conditions exist on Market St.

*Some of the delays to other traffic by Bloomfield and Paterson cars might be eliminated by a third track on Market St. north of the existing tracks and turning to the northbound tracks on Broad St. The Bloomfield and Paterson lines would then turn out of the string of Market St. cars near Lawrence St., and the group would turn up Broad, while the string of Market St. cars would be shot straight across on the second track. However, the third track would interfere with vehicular traffic and vice versa, so that this scheme does not appear entirely feasible to the Commission—Ed.

The Express Business in the United States has been the subject of a thorough investigation by the Interstate Commerce Commission, and the report of the Commission recently filed will result in marked reductions in express rates and notable changes in methods of conducting business, unless at the hearings, which commence Oct. 9, the express companies are able to show cause why the orders of the Commission should not go into effect. The investigation has covered the following points:

(1) Double collection of lawful charges.

(2) Overcharges and undercharges effecting discrimination between shippers arising out of an obscure rate system and ineffective revision and supervision of accounts.

(3) Indirect routing of shipments by the express carrier, resulting in unreasonable delays and defeating the reason for the existence of an express service as distinguished from ordinary freight service.

(4) Failure or refusal to deliver parcels to consignees located outside of arbitrarily established free-delivery limits without notice being given either to the consignor or consignee as to the extent of free-delivery territory.

(5) Unreasonableness of the terms of shipment imposed by the receipt given by the carrier.

(6) Delays in the settlement of claims for loss and damage.

(7) Excessive insurance charges when shipments are valued at more than $50.

(8) A confusing set of rules governing the classification of express matter which led to discrimination in rates between classes of shippers by providing obscure and insignificant conditions as the basis for classifications of which the initiated may take advantage to procure transportation at lower rates than are generally applied to the more uninformed portion of the public.

(9) Delays in the return of C. O. D. collections to consignors.

(10) The obscure statement of rates making the public dependent almost entirely upon the information furnished them by express agents.

(11) The unreasonableness of the rates charged by the carriers.

The rates proposed by the Commission are based on a block or zone system, each block being about 50 miles square and the United States containing altogether 950 blocks. The rates are made for packages weighing from 1 to 100 lb. between each zone and every other zone or block, the rate being the same for all cities within a block. The express companies will be required to publish a directory of express stations, showing the number of the block in which each station is located, and at every station there must be filed a single sheet tariff giving the rates from that station to every one of the 949 other blocks. The sheet must also state the local free delivery limits. For lightweight parcels the proposed reductions are considerable. The Commission will also insist on the most direct routings.

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EDITORIAL

A Presidential Address Which is a Notable Contribution to Engineering Literature

Were this not such a busy world a small volume might easily be written on The Presidential Address before technical and learned societies. It is often a difficult matter for a president to decide whether he shall review the progress made in the whole field or in a limited section of the field covered by his society, and in either case whether he shall limit the period covered to the interval which has elapsed since the last meeting of his society, or extend it to the past decade, the quarter, half or full century, or even to the whole life of the art or science concerned. Then, too, where the man who fills the presidential chair has himself made notable contributions to his science or art the question may arise—if he be a modest man—whether and to what extent he may properly discourse upon his own achievements or give voice to his own opinions or theories. Again, if the society be large and the attendance at its conventions relatively small, shall he make his appeal to the audience which faces him or to the wider circle of the membership which will read rather than listen to his address. And, in any case, to what degree shall he aim to instruct and in what measure shall he try to entertain? Of course there can be no single model, suitable to all societies and to all men called upon for presidential addresses. The wise and able president will try to suit his address to his own particular society, at a particular moment in its history, and perhaps with special reference to the meeting place; and he will use to the full whatever skill he may have to give the address literary form—an essential too often overlooked by those who preside over the deliberations of engineers and other men of science. The foregoing reflections have been caused by the presidential address of Henry M. Howe, before the International Congress for Testing Materials, printed in our issue of last week. We shall not attempt to classify the address in accordance with any of the standards which we have suggested, but it seems highly appropriate to call attention to it in the section of this journal devoted to Engineering Literature, since both as a presidential address and as engineering literature the address takes high rank.

Wasted Effort in Book Making

A reviewer ("H. J.") in *Science* for Aug. 30 has followed much the same line as did Dean John F. Hayford (Northwestern University) in reviewing Fergusson's "Percentage Unit of Angular Measurements" in our issue of June 13, 1912 (p. 1148). We quote with approval "H. J.'s" forceful opening paragraph:

> This is one of those costly volumes printed occasionally to advocate some novel idea; not actually incorrect, but yet quite without real value. Such books are full of pathos. One can see in their pages lost yet endless industry; painful longing for sympathetic appreciation; indomitable energy; the sacrifice almost of a life-time; and finally the refusal to accept even the kindliest adverse criticism. Were not the theories of Galileo received with incredulity? Are not my theories met by similar unbelief? Galileo was right. So then must I be also. Such is the fallacious reasoning consciously or unconsciously in the minds of men like Fergusson.

When there is so much scientific work that needs to be done it seems a pity that a man should spend 19 years, as did the author of the book in question, in computing tables which few but himself will ever use.

REVIEWS

Three Important Books on the Valuation of Public Utilities

Reviewed by LEONARD METCALF*

VALUATION OF PUBLIC UTILITY PROPERTIES—By Henry Floy, A. B., M. A., M. E., Consulting Engineer; M. Am. Inst. E. E., M. Am. Soc. C. E., etc. New York and London: McGraw-Hill Book Co. Cloth; 6x9¼ in.; pp. viii + 390; 8 text figures; 45 tables. $5, net.

ENGINEERING VALUATION OF PUBLIC UTILITIES AND FACTORIES—By Horatio A. Foster, M. Am. Inst. E. E., M. Am. Soc. M. E.; Consulting Engineer; Author of "Electrical Engineers' Pocketbook." New York: D. Van Nostrand Co. Cloth; 6x9¼ in.; pp. xvi + 345. $3, net.

VALUATION OF PUBLIC SERVICE CORPORATIONS—Legal and Economic Phases of Valuation for Rate Making and Public Purchase. By Robert H. Whitten, Ph. D. [With New York Public Service Commission for First District.] New York: The Banks Law Publishing Co. Buckram; 6x9½ in.; pp. xl + 798. $5.50, prepaid.

The publication of these three admirable books at substantially the same time clearly marks the active present interest of the public in the problem of the valuation of public-utility properties. May it not also be suggestive of the influence of a wider movement, of far-reaching importance to the future welfare and stability of corporations in this country—the effort of labor to right its wrongs and better its position through the agency of the national government, state legislatures and the courts, rather than by the older and cruder method of strikes and arbitration?

The problem is one of great interest to engineers, who must work hand in hand with the lawyers to assist the courts in its equitable solution. While certain rugged decisions have been rendered which are veritable guideboards in the uncertain ways of valuation, men familiar with this subject know full well how some of our respected justices have floundered, acting upon narrow and uncertain precedent instead of adding fresh light to the subject by clean-cut thinking. But the burden of ignorance in these cases does not rest wholly with the courts but often with the corporations themselves, which have failed to present their evidence in a sufficiently convincing way to prevent the repetition of old fallacies and the application of outgrown ideas to new and changing conditions.

The authors all recognize the inherent

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difficulties in valuation and make clear the need of breadth of information, judicial temper and close thinking on the part of the appraiser. Mr. Floy has well said: "This larger field of valuation work, however, has put new responsibilities upon the engineering profession, demanding something more, in the way of knowledge of values, and questions of law and economics, than mere construction has ever before required."

Mr. Floy's book is written from the analytical point of view, that of the practicing engineer, called upon to advise corporations and the public upon administrative problems as well as upon those of construction, and who has given particular stuly to the philasophy or underlying principles of valuation and the attitude and function of the court.

In his introduction he says that "the taking over by municipalities of privately owned water-works may be said to have originated the present era of appraisals and valuations in America. Consequently the water-works engineers were the first of the profession to be drawn into this department of engineering, and they have done much excellent pioneer work therein." This is undoubtedly true, and in passing it may be well to call pointed attention to the need of caution in applying methods evolved by engineers for the solution of valuation and rating problems in water-works practice, to the solution of kindred problems in the gas, electric and railroad fields, by reason of certain fundamental differences in these public utilities. Among these differences are the facts: (1) That water-works systems constitute natural monopolies, a situation quite different from that of the railroads, for instance, which serve various and different communities; (2) the period of initial activity in water-works building was prior to the year 1890, whereas many of the gas and electric plants are of very recent construction; (3) the life of the physical plant of water-works properties is much greater than that of the other public-service corporations cited; (4) the depreciation of water-works property is very much less, in terms of its cost, though not perhaps of its income, than that of the other public utilities mentioned, and radical changes in plant are of less frequence and importance, though the substantial reconstruction of water-works properties has occurred in many cases. Therefore, methods of valuation and short cuts in computation which may be sufficiently accurate for water-works problems may not always be applicable to the properties of other public service corporations, although the underlying principles governing their valuation must, in general, be the same.

Following the introduction is an excellent glossary of terms used in valuation work by the courts, public-service commissions and engineers, and at the end of the chapter a brief but good discussion of correct methods of determining average life in valuation work, worthy of the study of every engineer, as the term "average" is so frequently misused in this connection.

Mr. Floy recognizes cordially and quotes freely from the admirable work of certain public service commissions in this country. He says:

> In a broad sense the term Commission has come to include Federal, State and Municipal Committees or Boards having supervision of so-called Public Utility Corporations, such as railroad, gas, electric-light, street-railway, water-power, water-works, express, telephone, telegraph, and even pipe-line, wharfage or compress companies. Although few important valuations have yet been made by Municipal and none by Federal Commissions, much of the appraisal work that has been done by the State Commissions is of such high quality, although wrought out, in many instances, under disadvantageous circumstances, that it should receive due credit and recognition. The opinions, in most cases, show such thought and painstaking effort; the conclusions are usually so logical and the decisions based on valuations have been so frequently accepted as to give them a status comparable to those of a Court of Justice, that some knowledge of the procedure and appraisal work of Public Service Commissions is essential to a broad study of the subject of valuations.

The reasons for the creation of these commissions and the results accomplished by them are outlined. In this chapter also appears an interesting digest of the results of an inquiry by the National Association of Railway Commissioners into what has been done in the way of physical valuation and taxation of railways by different states.

Then follow chapters upon the making of appraisals and upon structural costs. The work of the commissions in determining land values is discussed in detail, as is the much debated question of the inclusion in or exclusion from reproduction cost estimates of the cost of paving over trenches, laid by the city subsequent to the construction of the pipe system by the corporation. The author points out the illogical position taken in this matter by some of our courts and commissions, and while admitting that in certain cases reproduction cost may not be a proper criterion of value, he soundly holds that in making an estimate of reproduction cost, the actual conditions of reproduction must prevail and the cost of the paving work be included, therefore, although not originally incurred by the corporation, as "there exists no judicial pronunciamento for taking a part of the estimated cost of reproduction and leaving out the other part."

Development, intangible and overhead expenses are then fully discussed, a matter of great importance, as the layman usually fails to realize how large a percentage of cost is generally involved in these items, being inexperienced in these matters. Next, the intangible elements of value are discussed. In these the author includes going value, as well as franchise, good will and contracts.

The chapter on depreciation is one of the best discussions of this subject which has come to the notice of the reviewer. In it are given the various methods of figuring annual and accrued depreciation which have been used heretofore, though it is frankly admitted that practice varies widely and has not yet crystallized into definite form.

The last half of the book, comprising Chapters 9 and 10, contains examples of appraisals of public-utility properties in New York and elsewhere.

The author cites opinions and recent practice freely, to give point and weight to his statement. The book is thoroughly readable, well considered and up to date, and will be found of interest and service, not alone to the practicing engineer, but also to the public official and general student of these questions.

Of very different character, though of service to many men, is Mr. Foster's book, which, while touching briefly upon theories of valuation and current practice, is written from the descriptive rather than the analytical point of view. It treats chiefly of the *modus operandi* of valuation, the forms and methods used by public-service commissions and appraisers, and gives the syllabi of some of the most important legal decisions and opinions which have been handed down in valuation and rating cases.

The opening chapter upon "Value" is devoted to a glossary of terms used in valuation work. One is surprised, however, at the author's statement:

> In appraising the property of a public-utilities corporation care should always be taken that the figures of valuation are based upon a simple engineering calculation, orginal cost, or cost of the property reproduced new. * * * * There can be no doubt, however, that there is but one legitimate value which is such as may be determined by competent engineers at the given date and under the conditions existing.

It has generally been conceded that the problem of valuation is in fact a complex problem involving a large measure of judgment, essentially a matter of opinion, and not solely a "simple engineering calculation." The statement that there is but one legitimate value "under the conditions existing" is sound if broadly interpreted, but as commonly, perhaps erroneously, used (basic) value may be modified by legal limitations or requirements. Thus valuation under the actual legal limitations as regards taxation prevailing in different states would give very different results for the same property, hence the purpose for which the valuation is made must be clearly defined and limited.

Next come chapters upon Purposes of Valuation, Directions for the Valuation

of Tangible Property, Instructions for Valuation (quoted from the opinions of Judge Savage of the Supreme Bench of the State of Maine in the Waterville and Brunswick cases), and Forms for Use in Making a Valuation.

The forms submitted are for the most part those "devised by the Joint Engineering Board of the Wisconsin Railroad Commission and the Wisconsin Tax Commission," and are valuable, having stood the test of repeated use. The notes accompanying these forms are too general to be of much service to the appraiser, and the book is weak in its discussion of unit prices and of the different bases in use for determining "normal" or current unit prices.

The discussion of the paving question, previously referred to, is inadequate, as is the reference to the method of determining land values. Incidentally, it may be said that water-works practice differs essentially from railroad practice, in regard to the applicability of overhead charges to the land items, no doubt in consequence of the fact that in water-works practice the purchase of the land frequently involves the making of more or less expensive surveys, legal descriptions, land takings, etc., as for storage and impounding reservoirs.

After a brief reference to the cost of valuation work, the subjects, Value of Good-Will, Going Concern, or Going Value, are taken up. The author fails to distinguish clearly between development expense and going value (or going concern value), and apparently falls into the error of combining with the reproduction cost estimates of physical plant, going value as determined by the method of development expense—thus confusing original cost with reproduction cost. Obviously, it is entirely proper to class the cost of developing the business with the original cost of the physical plant or property, but water-works engineers, at least, have long held that in valuing by the method of reproduction the financial condition of the company, as well as its physical plant, should be thus reproduced. While it is impossible to state how far courts have been influenced by such computations it is undoubtedly true that, in water-works valuation cases, computations of going value, determined by the method of reproducing the income, have been submitted alike by plaintiff and defendant. Moreover, while the public reports of the Wisconsin Commission make reference to the determination solely of the development expense, rather than of going value, the computation of the going value by the reproduction cost method has, nevertheless, always been made, as an aid to the judgment of the commission, and the fact must not be lost sight of that, as compared with corporate property in many states, the Wisconsin Commission is dealing with new properties and small cities, operating under conditions to which the methods used by them are probably more applicable than they would be in older communities.

The subject of Depreciation is treated with greater breadth, and in a manner which cannot fail to be helpful to many. The author recognizes the actual condition which has prevailed in the operation of the majority of public-service corporations in times past, and the new condition resulting from the decision of the United States Supreme Court in the Knoxville Water Co. case, which enforces proper allowances for depreciation.

Depreciation from decrepitude, obsolescence, inadequacy, or supersession, wear and tear and deferred maintenance are successively described, though the fact is not forcibly brought to the attention of the reader that allowances for all of these items are not generally to be added, and that certain of the items are to be used by way of limitation only.

The rules for depreciating railway and lighting plants prescribed in Great Britain by the Board of Internal Revenue and the Tramway and Light Railway Association are quoted.

The several methods of accounting depreciation—the straight-line method, the method of diminishing values, and the sinking-fund method—are discussed, and rates of depreciation and average lengths of useful life suggested by various authorities, for different structures, are given, together with tables, for the convenient application of these methods.

The amortization and the handling of depreciation funds by corporations, and the requirements of public-service commissions along these lines are then discussed. The investment by some of our corporations of their depreciation or sinking-fund allowances in bonds of the company, issued either against new construction or withdrawn from circulation, thus automatically keeping track of the amount of the depreciation allowance and assuring the maintenance of this fund as a true sinking fund, might well have been more clearly outlined by the author.

The questions of Appreciation, Franchise, Capitalization, and Control of Public Utilities are then successively treated.

The book closes with the full text of certain of the most important decisions rendered in valuation cases, the Kansas City Water-Works case, the Consolidated Gas Co. and Knoxville Water Co. cases—excerpts from the Smyth vs. Ames, the Kennebec Water District and other noteworthy cases, a limited bibliography and a good index.

It will thus be seen that the author has fairly met his effort to write a book, which he states in its preface shall give rudimentary information as to methods of valuation, and a condensed statement of theory, elaborated only in those elements most needed by engineers, and has produced a book which will inspire an interest in the subject and a desire on the part of the reader for further information.

Robert H. Whitten, in his book upon "Valuation of Public Service Corporations," has dealt with the "legal and economic phases of valuation for rate making and public purchase" from the legal, rather than the engineering point of view, giving no details of methods of procedure or forms used, and confining himself to a discussion of principles and citations from legal decisions of courts, arbitration boards, and masters, appraisal commissions, state railroad and public-service commissions. In his own words: "Following the detailed study of specific cases, with full quotations, there is for each subject a brief summary of the law and precedents, together with a statement or discussion of the economic principles involved."

It is a masterly work—clear, concise and convenient—a model of what a useful and authoritative reference book should be. The subject is well covered, the citations are broad, reasonably complete, and intelligently selected and arranged, and as the line between the findings or dicta of the Court, or authorities quoted, and the opinions of the author are sharply drawn, the book is not only bound to be of great service to those having to deal with rating and valuation problems in their various phases, but to exercise a powerful influence in shaping the future action of courts, and commissions passing upon these problems. Himself a trained statistician and Librarian of the New York Public Service Commission, First District, the author is well qualified for the work undertaken by him, which has been done fairly and without apparent bias, though in his expressed personal opinions the author leans to the public rather than the corporate point of view in his constant tendency to revert to original cost rather than present value as the most important yard stick for valuation.

In the review of a book of 800 pages for these columns, it is obviously out of the question to give the reader more than the briefest outline of the book and to call attention to some of its weak points, as well as its strong ones. A simple quotation of the captions of the 32 chapters will show clearly the ground covered:

Purpose of Valuation, Fair Value for Rate Purposes, Market Value as a Standard for Rate purposes, Cost of Reproduction as a Standard of Value for Rate Purposes, Actual Cost as a Standard of Value for Rate Purposes, Valuation of Land, Pavement Over Mains, Property Donated or Acquired Without Cost, Property Constructed out of Surplus, Unused Property, Average Price v. Present Price, Overhead Charges, Discount on Bonds, Working Capital, Piecemeal Construction, Adaptation and Solidification, Physical Depreciation, Cost-New v. Cost-Less-Depreciation, Functional Depreciation, Annual Depreciation Allowance, Going Concern in Purchase Cases, Going Concern in Rate Cases, Going Concern as the Value of a Created Income, Going Value Rule of Wisconsin Railroad Commission, The Theory

of Going Concern Value, Franchise Value in Purchase Cases, Franchise Value in Rate Cases, Appraisal of Franchise Value, The Theory of Franchise Value, Rate of Return, Rules for Appraisers in Maine Condemnation Cases, Bibliography of Valuation and Depreciation.

As an example of the author's clearness and conciseness of statement, and of his method of introducing the subject discussed in the chapter, the introductory paragraph from Chapter III, upon "Market Value as a Standard for Rate Purposes" is quoted:

Sec. 50. Usual meaning of market value. An appraisal of value is usually based largely on market price. A thing is worth what a responsible bidder will offer. An appraisal is an estimate of the amount that will normally be offered. It is thus that a piece of land is appraised and it is thus that a public utility plant would be appraised if it were a question of its transfer from one private proprietor to another. The market value theory recognizes most consistently that the business, whether it be a gas plant or a great railroad system, must be valued as a single unit. There is but one value and that the value of the going business concern. Structural costs, depreciated condition and many other things are considered, but only for the purpose of more accurately gaging the probable net income. If net income be guaranteed, all questions as to costs and intangible value may be ignored. Property has value as an investment only to the extent of the present and prospective net returns. If there are no returns, value disappears. The investment value of a property is the present worth of the prospective returns. In other words, the capitalized probable net return is the investment value. The capitalization rate depends on the rate of interest and the degree of risk. The probable net return and the capitalization rate determine market value, i.e., the value to the buyer and to the seller

The term "market value" as applied to a monopoly and not to an article of commerce which is bought and sold or traded in with sufficient frequency and by a sufficient number of buyers and sellers to establish a "market price" is, of course, a misnomer, but it is unfortunately in current use.

With reference to the cost of reproduction the author concludes:

Considered from all points of view the method of reproducing the existing plant under the actual physical and other conditions under which it was actually constructed seems fair to both parties. It is a rule that corresponds to the actual equities of the parties, while the other rule gives an unfair advantage, in some cases to the public and in other cases to the Company.

Here speaks the exponent of the public who seeks to enforce the doctrine of valuation by *original cost* rather than by the legal rule of *present value*, advocated by the corporation, and in force in all private and general business transactions. In the light of the past trend of court rulings, would not a fairer basis of determining reproduction cost involve the reproducing from the old original conditions of the plant in its present condition? The author's definition involves the reproducing of the work actually done by the company, not perhaps of the existing structure.

The author's discussion of "actual cost," the possibility of its accurate determination, and its utility as a standard of valuation is certainly not justified by conditions in many of the older communities of the East. In many cases original records are lacking, and in others no man could determine today the reasonableness of the original entries. Often little, if any, greater accuracy is possible in retrospective examination than in determination of present or estimate of future conditions in these cases.

The chapter upon valuation of land is admirable and outlines clearly the several methods of treating the difficult problem of the so called unearned increment in value.

In the discussion of "Pavement over Mains" crops up again the strong bias of the public-service commissions in favor of original cost, rather than present value, as a standard of valuation. If the reader will constantly ask himself the question, "Is this original cost or present value?" in reading the author's own comments and quotations from no less an authority than Commissioner Maltbie of the New York Public Service Commission, in the discussion upon the paving question contained in paragraphs 168 and 169, he cannot fail to be struck by the inconsistency of the position taken. It is unfortunate, too, that the issue should be clouded by any reference to ownership of the pavement. The paving work in reproduction is an incident of pipe laying just as is the digging of the trench. The question of the ownership of the pavement is at issue in neither case. The problem here involved is in many ways analogous to the appreciation of land values referred to previously, and it may well be suggested that the rule suggested by the author for application to quasi public corporations is quite different from that applied by the courts to individuals.

In the discussion upon "Going Concern as Created Income," the same strictures apply. The author prefers the Development Cost method of determination —clearly a reversion to original cost rather than present value. The author could not have been guilty of such a statement upon the reproduction cost method of determining going concern value as that contained in § 586:

A public water supply is a necessity. A light system is a necessity. They are utilities that cannot be permitted to stop. The consumer must use them or suffer irreparable injury. *It is fanciful to speak of a development period for the new plant under these conditions.* If the old plant were wiped out, the new plant would have the business at once if already constructed, and otherwise, as soon as completed and ready for operation,

had he studied the actual experience of New Orleans, which has recently built new works, taken over an old small local plant, and in spite of drastic legislation requiring the abandonment of cisterns, is, in fact, *not in fancy*, slowly developing going concern value at substantial cost. So, too, his dicta upon going concern value:

It is therefore neither actual cost nor cost of reproduction, but the capitalization of a certain monopoly value due to the fact that it takes time to construct a plant and time to develop business, and that during such time possible profits are lost to the new enterprise. Its basis is value to the purchaser and not actual cost or reproduction cost to the owner. The criterion is market value, not cost or cost of reproduction. The objections to using market value as a general standard of valuation for rate purposes have been discussed in Chapter III,

will not be accepted by many, who hold that not only is the development cost method of determining going concern value an original cost method, and so inapplicable to reproduction cost determination, but it is quite as impossible of accurate determination in many cases as the reproduction cost of the created income. While the critic has no brief for either method and recognizes the inherent difficulties of the problem, the reproduction method of determining going concern value is the outcome of an honest effort on the part of the engineer to meet the requirement of the courts that the true reproduction cost shall be determined, and with all its possible inaccuracies, it is the only method yet devised which in any sense approaches such a determination.

The danger of comment upon or application of decisions to other cases without a study of the evidence, is shown in the author's reference to the Cedar Rapids Water Co. case (118 Iowa, 234; 144 Iowa, 434; 32 Sup. Ct. R., 389), in his chapters upon Pavement Over Mains and Going Concern in Rate Cases. That the author is entirely candid and did not intend to misinterpret these decisions cannot be doubted, but inasmuch as the decisions in this case have frequently been misinterpreted, it seems wise, as a word of caution, to quote the following words from the brief of N. T. Guernsey, Esq.—one of the ablest corporation lawyers in the country, a student of economics, and a man of high ideals—in the Des Moines Gas Co. vs. City of Des Moines, *et al.* Case in the District Court of the United States, Complainant's Brief on Exceptions to Master's Report. The quotation, pp. 61-65, is as follows:

Any doubt as to the proper construction of the Cedar Rapids case is settled by an analysis of the figures. If we take the valuation of the physical properties which the state court took in the discussion of the question and make the deductions which it clearly makes, the conclusion that the court included an allowance for going value and an allowance for paving over mains is inevitable. We insert a computation with reference to the pages of the opinion which is reported in 144 Iowa, where the various items may be found.

"Plaintiff's chief expert estimated the physical properties to be worth" (p. 438, last line)..		$365,564.41
This included $43,580 "increase of value of pipes and mains because of being underneath the pavement" (line 25, p. 437).....		
Deduct the following items included in the foregoing total of $365,564.41 and definitely disallowed by the state court:		
(1) Working capital included at $25,000 and allowed at $2,500 (p. 433, line 23)..	$22,500.00	
(2) The so-called annex, real estate intended for future use, unnecessary for present use (p. 435, line 22, and p. 436, line 9).....	16,500.00	
(3) Deductions made by the court from the valuation placed by the complainant upon its real estate $15,000 or $20,000 (p. 436, line 20) say.....	17,500.00	
(4) Purifiers (p. 436, line 27).....	1,600.00	
(5) Deductions on account of excessive price of cast iron mains (p. 436, last paragraph) say.....	5,000.00	
(6) Marion high pressure line ½ of $5,483 (p. 437, line 23).....	4,112.00	
(7) Promotion and organization (p. 438, lines 21 and 31-2)...	14,943.69	
		$82,155.69
		$283,408.72

This amount, $283,408.72, is the maximum valuation of the physical property because only those deductions have been made that are specifically warranted by the opinion.

In the foregoing no deductions are made for either of the following items included in the $365,564.41 although the references to these items in the opinion unmistakably indicate that they were not allowed to their full amount:

Brought forward from preceding page.....		$283,408.72
(8) Interest during construction (p. 438 lines 20 and 24)	$22,415.00	
(9) Engineering (p. 438, lines 21 and 28).	18,679.61	
(10) Increased value of mains because of being underneath paving (p. 437, line 25).....	43,580.00	84,674.61
		$198,734.11

The court found (p. 439, line 33) that a fair valuation of the entire plant is "somewhere between $300,000 and $350,000." A deduction from this value of some amount between $282,408.72 and $198,734.11 above, will leave what the court allowed for going value. The following conclusions are inevitable:

(1) If interest during construction, engineering and increased value of mains because underneath paving were allowed in full, then the value of the physical property, aside from going value, is $283,408.72, and there is allowed as going value some amount between $16,591.28 and $66,591.28.

(2) The adoption of this theory would compel the defendants to abandon their contention that this case is an authority for disall wing paving over mains, at the same time compelling the concession that the valuation fixed included something on account of going value.

(3) To contend that the entire item of paving over mains was disallowed in this case, involves increasing the allowance for going value by the amount of this item, $43,580, which would make it somewhere between $60,171.28 and $110,171.28, an amount relatively so large as to render this hypothesis extremely improbable.

(4) If the items, interest during construction, engineering and increased value of mains because underneath paving, be substantially reduced, which in view of what is said about them in the opinion is clearly what was done, then the amount of such reduction must be added to what otherwse was allowed for going value.

It is therefore demonstrated that the Cedar Rapids case, instead of supporting the master's contention, is in fact directly opposed to it and incidentally is opposed also to his conclusion as to paving.

This mathematical demonstration removes all doubt as to the construction of the language in this opinion that has been already referred to. The court says (p. 434):

> As previously intimated the value of the plant is to be estimated in its entirety, rather than by the addition of estimates on its component parts, though the latter course will materially aid in determining value.

Again on the same page:

> The fact that the plant is in successful operation constitutes an element of value.

Again it is said:

> The value of the system as completed, earning a present income, is the criterion.

And again when it stated its conclusion at page 439 the court uses this significant language:

> A careful review of the entire record which has been repeated, has led to the conclusion that a fair valuation of the entire plant is somewhere between $300,000 and $350,000.

The language of these extracts taken in connection with the items which go to make up this valuation makes it impossible that the court should have intended to exclude either going value or appreciation in the value of the mains on account of paving over them.

In concluding this review of Mr. Whitten's admirable book, which, by the way, every student of valuation and rating questions will wish to have upon his desk, a word may be said upon the attitude of public-service commission upon the proper basis of public-service corporation valuation and rating. As Guernsey has well said, fundamentally there can be but one value upon one property, best defined as the Commercial Value or the value acceptable alike to the willing buyer and the willing seller, though this value may be modified largely by arbitrary legal requirements, as for taxation, public-service commission rating, or other purposes. Whatever may be the view of different commissions as to the proper basis for valuation or rating, and the requirements or limitations of the laws under which they act, in the long run value as defined above will control, as anything short of it will prevent capital from entering this field of public service.

Unfortunate, indeed, then, is it for the State, the Courts or Commissions of which take a narrower view than this of valuation and seek a narrower view than this of valuation and seek to limit value to cost, and fair return to any arbitrary basis, incommensurate with the risk involved and with the risk involved and with the return enjoyed in other fields of activity. Certain of our public commissions fully appreciate this fact, but fair play and the stability, if not safety, of our institutions and people, demand that those dealing with these problems shall approach them with a fitting sense of deep responsibility.

Stationary Gas Engines

GAS-ENGINE PRINCIPLES—By Roger B. Whitman, Author of "Motor-Car Principles." New York and London: D. Appleton & Co. Cloth; 5x7½ in.; pp. xv + 248; 74 text figures. $1.50, net; postpaid, $1.62.

The aim of the author of this little book has been to give to the non-technical reader, who may be ignorant of even the elementary principles of physics and mechanics, a fairly clear idea of how the ordinary stationary gas engine operates. Great pains has been taken to avoid so far as possible technical words, and to choose illustrations which can be understood and appreciated by almost anyone. Special praise may be given to the earliest chapters of the work, particularly the opening chapter which explains the general principle on which a gas engine operates, and the simplicity of the explanation in this chapter is admirable. When the reader comes to the chapters describing ignition systems, however, ne will find probably much more difficulty in obtaining a clear idea of the mechanism. This is natural, however, since the necessary complexity of the electrical apparatus almost defies the attempt to make its principles of operation clear to the reader who lacks even an elementary knowledge of physics.

In the endeavor to illustrate the principles of operation by the use of familiar illustrations the author sometimes makes statements which will hardly bear close analysis. In explaining why compression of a charge in a gas engine increases its efficiency, he says: "The same principle applies to a gun if the charge of powder is rammed down hard. The bullet will be fired with much more force than would be the case if the powder is poured loosely into the barrel."

One difficulty which will confront the average non-technical reader who attempts to use this book to obtain an understanding of his own gas engine is that the description necessarily has been made applicable to gas engines in general. The author has, therefore, been obliged to include descriptions of some of the principal variations in design. The reader, therefore, will have to have intelligence enough to enable him to select the description which applies to his own machine.

While many buyers and users of gas engines may not be able to find in the book just the information needed to enable them to cope with some particular trouble, any engineer or mechanic who happens to be ignorant of gas-engine operation can very readily acquire from this little treatise in a short time a fairly clear idea of the foundation principles, at least, on which the machine operates. It may be added that the book refers specifically to stationary internal-combustion engines. Automobile engines have been treated in a similar elementary way in a separate treatise by the same author.

Many Minds on Scientific Management

Reviewed by FRED J. MILLER*

ADDRESSES AND DISCUSSIONS AT THE CONFERENCE ON SCIENTIFIC MANAGEMENT—Held at Tuck School, Dartmouth College, Oct. 12-14, 1911. Hanover, N. H.: The Amos Tuck School of Administration and Finance, Dartmouth College. [Selling agents: The Weekly Bulletin Publishing Co., 183 Essex St., Boston, Mass.] Cloth; 6x9 in.; pp. 388. $2.50, net; by mail, $2.75.

PRIMER OF SCIENTIFIC MANAGEMENT—By Frank B. Gilbreth, M. Am. Soc. M. E.; Consulting Management Engineer. With an Introduction by Louis D. Brandeis. New York: D. Van Nostrand Co. Cloth; 5x7¾ in.; pp. viii + 108. $1, net.

In October, 1911, there was held at Dartmouth College a conference on Scientific Management. Its primary cause seems to have been the interest taken in the subject by Harlow S. Person, Director of the Amos Tuck School of Administration and Finance at Dartmouth, who, previous to the conference, had delivered an address upon its subject before a society of the college in which address he evinced not only considerable interest in the subject, but an excellent comprehension of its fundamental principles. This address opens the volume before us. Discussing the nature of the new system, or philosophy of management, and apparently in answer to the assertions so often made that there is "nothing new in it," "it is only common sense," etc., etc., he says:

> If the inventors of the aëroplane had brought its parts one at a time before the public and proclaimed each as something new, they would have been ridiculed. But when the perfected aëroplane was brought out and men actually flew, the Wrights were acknowledged great inventors. Old and familiar mechanical devices had been brought into new relationship expressing a new ideal. In like manner many writers and speakers have observed only the devices of Scientific Management and have pronounced them old and familiar. They have failed to see the whole and to appreciate the view that it is a union of many old devices with a few new ones in a relationship and expressing a new ideal of business organization and mangement.

This address is in itself a good summary of Scientific Management and it is followed by others presented by men who have had varying amounts of actual experience with it; Mr. Taylor himself delivering the first formal address of the conference as well as speaking the final word, between which many speakers, representing many widely diverse industries and viewing the matter from many different angles, are here on record.

Mr. Taylor shares the common lot of all innovators in that he is quite commonly misunderstood, chiefly because opinions of him and of his work have been too often based upon detached, epigrammatic sentences, which, taken by themselves and interpreted in the light of the ordinary knowledge of management possessed by most of those who manage or who study the art, seem to mean something entirely different from what they really do mean, or what they signify to Mr. Taylor himself.

This address has evidently been carefully prepared. In it Mr. Taylor avowedly undertakes to say what Scientific Management is not and *per contra* what it actually is. He manifestly desires and intends to be entirely candid and to convey an accurate idea of the system. For those who have had some experience with it, or who have had some opportunities of otherwise studying it, the address will be entirely understandable; to others not so much so; though even the latter, if they will read in recognition of the fact that here is a sincere man earnestly trying to convey an idea of a work in which he was engaged for thirty years, to which he devoted the full powers of a most earnest nature, backed by extraordinary ability, and in which he now has no other interest except that of a natural pride in good work accomplished, may derive much information from it.

He says a good many rather startling things. For instance: "It [Scientific Management] is a complete change in the mental attitude of both sides [employers and employed] toward their respective duties and toward their opponents." It would probably be more accurate to say that Scientific Management leads to, or induces, such a change of mental attitude, but however that may be, no one at all familiar with the attitude generally existing, taking all our industries together, can well doubt the desirability of a change.

Particularly does Mr. Taylor emphasize the fact that the system of management devised by him usually involves far more change for executives than for workmen and he plainly says that in the work of changing from the old to the new system nine-tenths of whatever difficulty has to be overcome is with the management and only one-tenth with the workmen. Of course he means the real difficulties, not the imagined or apprehended ones.

To the easy critics of Mr. Taylor and his work might be commended the reading of pages 37 to 41, inclusive. Here he describes in detail just what was done by him in the matter of reducing to a science the simple occupation of shoveling various materials. These few pages give a very good idea of what Scientific Management is and the results which may possibly be attained by it. If any one had previously done anything at all like what is there described it does not appear upon the records.

It is a familiar fact, however, that in order to drive a truth home to the minds of any great proportion of a given body of men, that truth must be presented in many forms—viewed from many different standpoints. In the book under review this is done by a host of men, including among those best known to engineers (besides Mr. Taylor) Henry L. Gantt, Harrington Emerson, James M. Dodge, Henry K. Hathaway, M. L. Cooke, Sanford E. Thompson, Carl J. Barth, William C. Redfield, Frank B. Gilbreth, Edward Robinson, and Arthur G. Webster.

Where the book records questions and their extemporaneous answers, a good deal of judicious editing might advantageously have been done, but most of the carefully prepared addresses are of great value, though somewhat uneven and naturally lacking somewhat in consistency.

Many citations of improvements made will be jeered at because it will be considered that they are nothing more than the records of advance steps that have been taken by able managers everywhere and that always have been taken by such men without a thought that they were doing anything especially scientific or remarkable. The discovery, for instance, that gear-cutter arbors must have a diameter sufficient to give adequate stiffness and to permit ample driving force being applied to the cutters is not new nor peculiar to Scientific Management; yet Mr. Barth cites such an instance as though it were; at least he is sure to be so understood.

Again, the discovery that the best grades of leather belting are generally more economical than any inferior grades is not new, nor can Scientific Management claim it as peculiarly one of its elements; yet at page 86 it is referred to by Mr. Emerson in a manner almost sure to be taken as indicating his belief that money will be wasted on inferior belting until a Scientific Management practitioner is employed. And the sad feature of the case is that such a statement is more or less liable to obscure the fact that Mr. Taylor and Mr. Barth really have, as a part of their work, discovered and revealed most important new facts about leather belting—on record in the *Transactions* of the American Society of Mechanical Engineers and elsewhere, though not referred to in the book under review. The same speaker, further on, dips into political economy somewhat, only to reveal that he has given the subject little or no serious thought—has not in the least grasped the import of the indictment brought by serious thinkers against the modern development of monopolies and is only threshing over old straw. Of course, one has the right to do this if he chooses, but it is a pity that Scientific Management has to be made to appear in some degree responsible for it. However, the vivid picture Mr. Emerson in his last paragraph shows us of a too common form of so called management goes far on the road of atonement.

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Mr. Kendall is manager of a printing establishment, but no one who has to do with the management of any kind of an industrial establishment can fail to learn much from what he says, nor from what is said by Mr. Dodge, who follows him. As is well known, Mr. Dodge has long been a convert to, user and defender of, Scientific Management. It is significant that he says "Certainly, where human elements are introduced into a problem, scientific methods alone will hardly achieve a complete solution." It is one of the most common errors to suppose that in this Mr. Dodge differs from others who understand the subject; the fact being that benefit to the workmen is always strongly emphasized as an absolutely necessary part of successful operation. The closing paragraph of Mr. Dodge's admirable address is worth quoting: "Herbert Spencer said that there is a principle which is proof against all argument, and which cannot fail to keep a man in everlasting ignorance; this principle is, to condemn before investigating."

No one who understands something of Scientific Management and who is acquainted with its literature can avoid the feeling that the book of books on that subject has not yet appeared. The one who will eventually write such a book must not only have a profound knowledge of a broad and deep subject, but must be able to stick to his subject and eliminate the chaff. This book contains some chaff, as a book must that is made up in this way, but it contains an abundance of the best material and he who has a sincere desire to understand a subject which is bound to influence our industrial development to a very important degree can scarcely afford to miss reading it.

As explained in the publisher's preface, this book consists of a series of questions asked of the editors of a popular magazine by its readers as a result of the publication of an article by Mr. Taylor on the "Principles of Scientific Management," with the answers to these questions by the author, Mr. Gilbreth. The form thus given to the book makes it somewhat fragmentary—makes the treatment of some phases of the subject too brief for full presentation and gives the book the general appearance of being a rather unscientific treatment of a scientific subject.

Nevertheless if nothing were known of its author except what is shown in this unpretentious volume, that would be enough to show that he is familiar with his subject by actual experience rather than by the acquirement of knowledge about it at second hand and the reader who will carefully study these answers to questions, covering most, if not all, of the objections usually brought against Scientific Management, may go far toward comprehending the whole subject.

The questions are arranged in five groups or chapters dealing with Definitions of Terms; Laws or Principles; Applications of the Laws; Effect of Scientific Management on the worker and Relation of Scientific Management to other Lines of Activity.

Although, for the reasons given, some of the answers fall short of being completely satisfactory, careful consideration of many of these will repay the sincere seeker for information. Among these are especially those treating of the Nature of Time Study; the "Task" as used by the practitioners of the new art; Object of Time Study; Standards of Accomplishment; Functional Foremen; Rate of Compensation; Comparison with Piece Work; Loyalty, and Welfare Work; Introduction with Minimum Disturbance; Time Required to Install; Time Required to Begin to get Results; and the Magnitude of those Results Compared with the Cost of Installation; Making Machines out of Men; General Effect upon Employees, Skilled and Unskilled; the Speed Boss and the nature of his duties; Effect upon Initiative of Employees: Promotion; Guaranties of Permanence of Rates Once Set.

The author declares the "great fundamental" of Scientific Management to be, time study: yet it is a fact that very important favorable results have been obtained by Scientific Management in a number of manufacturing establishments before any time study had taken place and it is quite certain that, especially in large manufacturing establishments, where the work involves many minutely divided operations, the lost motion to be found in purely administrative functions —those which have to do with the rapid and orderly progress of work from one stage to another and the avoidance of periods of idleness and disadvantageous working of machines—is often of very great importance, if not indeed of prime importance.

There has been, and still is, very much misunderstanding and misinformation about Scientific Management and very many have discussed it who have manifestly known nothing about it—have even possessed negative knowledge of it, as Chas. T. Porter declared he did of the science of mechanics at the beginning of his mechanical career, i.e., he had a lot of things to unlearn. Such people are quoted as saying "the speed boss is the man who drives the slaves." Mr. Gilbreth shows that the speed boss does nothing whatever except to see that machines, not men, operate at a predetermined proper speed and that all difficulties in the way of doing this are overcome; thus coöperating with the workmen in the earning of high wages, as well as with owners in getting a high rate of production.

Much has been said about "driving men beyond the limits of human endurance." At Page 67 we find the following:

> Taylor has found, by the use of the stop watch and by timing thousands of cases, that some work requires that a man shall actually rest 50% of the entire day, and that practically all work requires more than 12½% of rest. Now, that is one hour in an eight-hour day, and it does not sound nearly as much like "taking the last drop of blood" as does the old method of management, under which, if the manager heard that the man rested one-half hour every day, he saw to it that the man was discharged.

In the judgment of the reviewer the final chapter of the book weakens it somewhat. That is because it is more or less speculative in character and contains statements which are sure to be questioned by those whose competence for such questioning does not and needs not to depend upon a practical acquaintance with Scientific Management.

There is as yet little or nothing to show what the ultimate general effect of Scientific Management will be upon the social organization. It is without doubt strictly analogous, economically, to labor-saving machinery. Labor-saving machinery has by no means solved the problem of distribution and Scientific Management seems as little likely to solve it. This final chapter, however, does not affect the fact that Mr. Gilbreth has, in the previous chapters, written with the knowledge that comes of experience, and has produced a book of real value.

The useful pamphlet "On the Measurement and Division of Water," written by L. G. Carpenter, while Irrigation Engineer, Colorado Agricultural Experiment Station, Fort Follins, Colo., and published in 1890, and (enlarged) in 1894, has been revised by the author (Equitable Building, Denver, Colo.) after having been out of print for some years. It now appears as Bulletin 150 of the Station. In a letter of comment on the Bulletin Mr. Carpenter says:

> The purpose of the bulletin, as is evident, is to be useful to those having to deal with water and hence discussions are avoided.
>
> The formula for the condition which often arises where weirs are not level (p. 35) to enable the ordinary tables to be used, is new.
>
> I also think the table for submerged weirs is the most convenient for use of any form for such weirs that I am acquainted with. The measurement of back water is very unsatisfactory and such formulas as those of Francis or Herschel are unsatisfactory in application because of that difficulty. The table is based on using the ordinary weir formula and then correcting the result according to the depth of the back water. As this correction does not vary rapidly it gives a fairly satisfactory method.
>
> The trapezoidal weir to which I gave the name Cippoletti and which was first described in English in this bulletin, is used almost entirely throughout the western United States and Canada.

Hancock and Slocum's "Strength of Materials" Revised

Reviewed by LEWIS J. JOHNSON*

TEXT BOOK ON THE STRENGTH OF MATERIALS—By S. E. Slocum, B. E., Ph. D., Professor of Applied Mathematics in the University of Cincinnati, and E. L. Hancock, M. S., Professor of Applied Mechanics in Worcester Polytechnic Institute. Revised edition. Boston, New York, Chicago and London: Ginn & Co. Cloth; 6x9½ in.; pp. xxxvi + 372; 197 text illustrations. $3, net.

The preceding edition of this work was reviewed by the present writer in these columns nearly six years ago (Dec. 13, 1906, p. 632). The general comments on this textbook and its type there expressed still hold good, although some of the specific shortcomings which this particular work then embodied have been corrected. Like so many other books on its and kindred subjects, it is likely to cause a student who is trying to think and to grasp reasons, much unnecessary difficulty. For a student who wishes to gather formulas and results and get a certain show of facility in the beaten paths, works of this type may serve the purpose. But it cannot be maintained that they are as well suited as they might and should be to develop real power—power to originate, to strike out on new paths and to solve problems hitherto not included in a young man's or any one's else experience. And this is the power among others that differentiates the engineer from the mechanic. The fault may be covered by the term lack of clearness and comprehensiveness in the treatment of fundamentals.

It is easy to understand how gifted mathematicians may like to revel in flat plates, the shearing deflection of beams, and other subjects on the verge of the unknowable. But great attention to these things does not make up for such a misleading assertion as "the moment of inertia depends for its value solely upon the *form* of the cross-section," as if the size did not enter; or for a confusion of neutral axis and gravity axis just because they are usually coincident; or for a failure to make clear when and why the center of moments in computing the bending moment must be taken at the center of gravity of the section in question; and when it is not essential but is a mere matter of convenience where it is taken; or for a failure to point out (and show why) that the closure of equilibrium (string) polygon is a graphic equivalent to the satisfaction of the condition that $\Sigma M = O$, of equally universal significance, and not a mere trick to locate a resultant or determine reactions at the ends of a simple beam; or an assertion to the effect that a series of successive strings intersecting on lines of action of forces and inclosing space with the help of a line drawn from a random point on one string to a random point on another makes a closed equilibrium polygon; or a starting out to prove a thing just stated to be obvious, and then casually omitting a part of the proof just as essential as the part given; or giving a method of running an "equilibrium" polygon through three given points which reveals only part of the possibilities and meaning of the process, and leaves an impression of restrictions that do not exist; or making or repeating the assertion unqualified and in italics that "if for any given arch it is possible to draw an equilibrium polygon which shall everywhere lie within the middle third of the arch ring, the stability of the arch is assured." This use, and more particularly, the general use of the term equilibrium polygon, or force polygon, exclusively for one of the two equilibrium polygons is in line with all the rest. The so called equilibrium polygon is no more an equilibrium polygon than the so called force polygon, and the latter no more a force polygon than the former. The force polygon, so called, simply precludes translation, the equilibrium polygon rotation. Together they establish equilibrium. String polygon for the latter and magnitude polygon for the former are terms which are, at least, unobjectionable and less misleading.

These are faults exemplified in this revised edition as well as in the former, and are of the type to be found in many other similar works. They are minor points, it may be granted, from the point of view of those who know the subject—and such would hardly turn to such books—but they do inexcusably handicap the student and even the older engineer, who has to branch out a bit from his usual line in some emergency.

It should not be gathered from this that the work before us is relatively bad. It is not. It is simply not free from a very common, and, I may add, orthodox type of faults. These faults tend to produce in the learner's mind an impression that he is dealing with a disconnected and largely whimsical set of tricks, instead of a subject the unity and logical coherence of which is not only fascinating but little short of inspiring.

Writers of such books seem to forget that young engineers' troubles come from a lack of power to think straight about simple things rather than from lack of knowledge of the abstruse ones, and that the simple things in their length and breadth are the hardest things to grasp of all. Once grasped the rest is a matter of building on with steady progress assured. On such a basis, explorations into the realms of the theory of least work and similar fields can be safe and permanently fruitful and not otherwise. They should be foregone entirely rather than risk the full grasp of the simpler things.

But to turn to the special features of the new edition. The changes in the revised edition consist mainly of the addition of new matter covering about 80 pages in all. Some of this new matter fills in omissions and some of it covers new developments in the science. The part of it, however, that will doubtless contribute most to an increased usefulness for the work is the addition of nearly 150 original illustrative problems, well distributed through the analytical portion of the work. These problems are usually of a plainly practical character which cannot fail to add materially to the student's interest in his work and strengthen his grasp on the subject. A number of pages of tables of properties of materials of rolled-steel sections, logarithm tables and other mathematical data have been added.

Other new matter is in the line of amplifying explanations in some of the more abstruse portions—such as those relating to Poisson's ratio, stress in curved members, the theorem of three moments, etc. The most important addition to the text pertains to reinforced-concrete beams, shrinkage and forced fits, eccentrically loaded columns, riveted joints, torsion of springs, collapsing strength of tubes, and to the method of least work by which is derived and applied the Fraenkel formula for the bending deflection of beams, and also a general formula for the shearing deflection of beams, hitherto unpublished.

One point of criticism for the revision which does not hold for the earlier edition is giving 3000 lb. per in. as the average ultimate compressive strength for concrete, without accompanying limitations and warnings. It is a courageous person who would attempt to state a figure for this quantity, to say nothing of putting it so high. The figure 1500 – 3500, of the former edition, was less likely to do harm.

In the field of physical properties of materials, to which the last hundred pages are devoted, the new matter naturally refers to the newer topics, such as vanadium steel, manganese steel, the high-speed steel, reinforced concrete, and preservative processes for timber and their effect—all treated in a highly condensed but useful manner.

To one already familiar with the earlier edition, the important comment now to be made is that this edition is a substantial improvement. To one to whose attention it thus comes for the first time it can fairly be said that this book is one of a number of modern textbooks on the subject among which a choice is by no means easy nor sure to be satisfying, though all are in the first grade of existing works. There is still room, so far as the writer is aware, for the rigorous, lucid, suggestive and invigorating text-

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book on strength of materials which we all have longed for since the days of our youth. But it may be granted that it will be no easy task to write it.

Sewerage of British Sea Coast Towns

REVIEWED BY JOHN H. GREGORY*

THE SEWERAGE OF SEA COAST TOWNS—By Henry C. Adams. Assoc. M. Inst. C. E., M. I. Mech. E., etc.; Consulting Engineer. New York: D. Van Nostrand Co. London: Crosby Lockwood & Son. Cloth; 5½x8¾ in.; pp. 134; 44 text figures. $2, net.

This small book, consisting of 15 chapters and 125 pages, treats in a brief and elementary way of some of the problems entering into the sewerage of sea-coast towns. The book is written from the standpoint of an English engineer and English units and terms are used throughout.

In the first four chapters the author considers the Formation of Tides and Currents, Observations of the Rise and Fall of Tides, Current Observations and the Selection of Site for Outfall Sewer.

Following these chapters one chapter is devoted to Volume of Sewage, in which is discussed the volume of sewage per capita to be allowed for a resident and transient population. While an allowance of 15 gal. (18 U. S. gal.) of house sewage per capita of resident population, which the author cites, may be sufficient for some small English seacoast towns, it would hardly be considered safe practice to allow such a small volume of house sewage per capita of resident population in designing a sewerage system for a town of any size.

In the chapter on Gauging Flow of Sewers the author devotes nearly all of the space to a discussion of the flow over weirs and gives two tables for computing the discharge, one for rectangular weirs and one for triangular notches. Several different formulas are used, but the matter is not presented in such shape that one can tell what coefficients have been used without computing them from the figures given. The units adopted, namely, gallons per hour and cubic feet per minute, are not those generally employed.

Two chapters are devoted to Rainfall and Storm Water in Sewers. Rainfall records of the Birmingham Observatory are quoted and the intensity of the rainfall and the amount of storm water reaching sewers is briefly discussed. Brief notes are also given on storm overflows and on the intercepting of the dry weather flow in combined sewers.

In Chapter IX the subject of Wind and Windmills, and their application to the pumping of sewage, is taken up. From the text it would appear that the author's experience with the pumping of sewage had been rather limited and he does not seem to favor those methods which are commonly and most frequently used. In considering the windmill for the pumping of sewage the author states that "any type of pump can be used, but the greatest efficiency will be obtained by adopting a single acting pump with a short stroke, etc. . . ." The opinion is ventured that but few engineers would fully agree with the author's views regarding pumping.

Chapter X treats of The Design of Sea Outfalls and details of a few which have been built are given. The Action of Sea Water on Cement is taken up in the following chapter and reference is made to experiments which have been carried out in several countries.

Chapter XII, on Diving, which is quite interesting reading, opens with the statement that "The engineer is not directly concerned with the various methods employed in constructing a sea outfall, such matters being left to the discretion of the contractor." Perhaps the engineer is not "directly" concerned, but he should at least know that it is practicable to build the sea outfall which he designs.

In the chapter on The Discharge of Sea Outfall Sewers the author discusses briefly the subject of allowing for the additional head required to discharge sewage into sea water when the outlet is at some depth below the surface of the sea water and also the method of determining the size of the outfall pipe.

The last two chapters are devoted to Trigonometrical Surveying and Hydrographical Surveying and treat briefly of some of the computations and methods which are used in this class of work.

In conclusion, it may be said that, while many engineers would hardly agree with some of the views expressed by the author, the book may be of considerable service to a young and inexperienced engineer, as the treatment is elementary throughout, but it should be used with caution as it might be difficult for such a person to separate the wheat from the chaff. An engineer experienced in sewerage and sewage disposal work will find but little in the book which will be of real service in helping him to solve the problems with which he is confronted.

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The report of the British government commission, headed by Lord Mersey, which investigated the loss of the "Titanic" has been published in separate pamphlet form by the government, under the title "Shipping Casualities (Loss of the Steamship 'Titanic')." An abstract of the report appeared in Engineering News, Aug. 15, 1912, p. 311. The report may be purchased from Wyman & Sons, Ltd., Fetter Lane, E. C., London. The price in London is only 7½d., equivalent to 15c., but on this side of the water the cost would probably be 25c.

Electrical Illumination

MODERN ILLUMINATION THEORY AND PRACTICE—A Handbook of Practical Information for the Users of Electric Light, Architects, Contractors and Electricians. By Henry C. Horstman and Victor H. Tousley. Chicago, Ill.: Frederick J. Drake & Co. Leather; 4½x7 in.; pp. 273; 29 text figures. $2, net.

The authors of this handbook have made what seems like a simple and useful compilation of what we may call the "art" of electrical illumination. They have paid particular attention to practice, giving only such theoretical discussions as were absolutely necessary and these are few indeed since "illuminating engineering" is an art rather than a science and the requirements of good taste frequently upset the nicest calculations.

The authors start out with a brief discussion of the principles of vision and an outline of light measurements, before showing fundamental pre-calculations of illumination to be secured. Then they catalog the characteristics of the different available illuminants and the effects of the various shades and reflectors that are being used. Present practice, and the reasons therefor, in the location and heights of lamps, in the choice of light sources, etc. are given under the heading "Practical Considerations." A large part of the book is given up to hints on what has been found desirable for particular installations, such as apartments and houses, stores, art galleries, banks, auditoriums, hospitals, libraries, factories, exhibition windows, streets, etc. A part of the book is devoted to tables for shortening computation of illumination from different arrangements of light sources, for calculations of wiring systems, etc. At the end is a glossary of technical terms, together with square-root tables and cards of accepted symbols for wiring plans.

In the main the authors have done their work creditably. Minor criticisms may be made of the text. For instance, early in the book it is stated that the candlepower of headlights may be computed by reading the illumination on an illuminometer and multiplying it by the square of the distance, the authors forgetting for the moment that the rays from one of these headlights are practically parallel and that the illumination does not follow the inverse square law. In another place the familiar formula for the illumination on a surface not normal to the rays of light is given with the statement that "the formula need not be explained, it being sufficient to state that it is in general use." It would not have taken more space to explain that the proof was by simplest trigonometry. In describing the American tungsten lamp, which carries the trade name "mazda," the authors have not seen fit to inclose this in quotation marks as they have the "gem" (metallized carbon-filament) type. Then there is the statement that tungsten lamps

are not made in small sizes for standard voltages of 110 or 220. Just before the book was published the lamp manufacturers announced a 12-c.p. type for this service. In describing the Moore vacuum tube light it is stated that the high potential apparatus should be installed in steel cabinets, etc. This is true, but the apparatus is installed by the manufacturers in no other way. Along in the middle of the book, in discussing shades and reflectors, is a statement that it is preferable to use glass of a high absorptive power to reduce intrinsic brilliancy. This is admitted to be necessary sometimes for artistic effects, but ordinarily the effort is to use a diffusing rather than an absorptive medium to protect the eyes.

An Elementary British Text-Book on Heat Engines

Reviewed by LIONEL S. MARKS*

HEAT ENGINES—By Herbert A. Garratt, Assoc. M. Inst. C. E., M. I. M. A.; Principal of the London County Council School of Engineering and Navigation. London, England: Edward Arnold. New York: Longmans, Green & Co., Selling agents. Cloth; 5x7½ in.; pp. xii + 332; 174 text figures, including 3 folding plates. $1.70, net.

There are two conditions in the education of the mechanical engineer in Great Britain which are different from those obtaining in the United States, and which have, necessarily, an important influence on the character of textbooks designed for the use of engineering students and of engineers. The first of these is the small number of students at educational institutions of college grade, and the comparatively large number of students obtaining their fundamental instruction in engineering at night schools and at technical day schools. The normal method of preparing for the profession of mechanical engineering is to enter an engineering works as an apprentice and to study the fundamental principles of the science at night schools. This has resulted in the growth of numerous and excellent night schools and in the development of a curriculum, of teachers, and of textbooks specially adapted to night-school conditions. The second important difference from American methods is in the matter of examinations. The night schools commonly receive subsidies from the government and the amount of the subsidy is based upon the results of examinations conducted by the Boafd of Education of the government. The examination papers are written by a special body of examiners and are the same at all schools. The attainment of engineering apprentices is commonly measured by their success in the government examinations, and their promotion not infrequently depends upon it. This system of government examination and certification results in a standardization of engineering education such as is unknown in the United States. It necessarily has a large influence in determining the method of treatment and the scope of all textbooks intended for use in technical schools.

The book under review is intended for engineering students in night schools, and also for engineering draftsmen and others engaged in the practical design and manufacture of heat engines; but is not intended for those who are enjoying or have enjoyed the privilege of a college education. As the author states, it "is intended to appeal chiefly to those engineers who wish to have a sound understanding of the principles on which their work is based . . . but who have not the time or inclination to deal with the subject in its more abstruse and mathematical aspects."

One of the marked features of the examination papers which are commonly set by the Board of Education is the number of questions asking for constructive details of special machines built by certain well known manufacturers. To meet this requirement, the author has devoted a considerable part of his book to drawings and descriptions of such special appliances. As these are almost exclusively British, this feature alone tends to make his book of comparatively little value to American engineering students at day or night technical schools. The proportion of the book which is devoted to that fundamental theory which is equally valuable on both sides of the water, is hardly sufficient to justify the use of the book here. Such English works on heat engines as those of Ewing and Ripper have a very distinct place in this country, because they deal more thoroughly with the fundamental theory and devote only a negligible proportion of their space to the consideration of the details of special machines. Since they are intended for college students, they do not have to devote so much space to practical details.

The subjects taken up in the book (a chapter is given to each) are: The measurement of heat and sources of heat, the combustion of fuels in boilers, the formation of steam in boilers, the properties of steam and gases, the action of steam in reciprocating engines, the mechanism of reciprocating steam engines, steam turbines, condensers and auxiliaries, internal combustion engines, testing of heat engines, and refrigerators.

The fundamental theory is presented very sketchily, and in the manner adapted for those who wish to know *about* the thing rather than for those who wish to know the thing. The value of much of the descriptive matter is vitiated by being too general and by lacking sufficient illustration. On the other hand, many parts of the subject are well illustrated; for example, the classification of steam turbines is very excellently illustrated by a whole series of diagrams.

Perhaps the best part of the book is that dealing with valve gears, governors, and reciprocating parts. The work is fairly well up to date in most respects, but contains a few statements with which the reviewer cannot agree. For example, the author states that the use of a dry air pump is of no great advantage without the addition of a special cooling device, a statement which is not at all borne out by ordinary practice. His definition of anthracite as a coal entirely free from hydrocarbons, consisting of about 88% of carbon, the remainder being incombustible matter which remains in the form of ash, cannot be accepted. These are but minor matters in a book which is generally accurate. Doubtless this book will adequately fill the purpose for which it is intended, but it would not seem to have any justifiable place in our technical schools.

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AN UNSINKABLE TITANIC—Every Ship Its Own Lifeboat. By J. Bernard Walker, Editor "Scientific American." New York: Dodd, Mead & Co. Cloth; 5¼x7¾ in.; pp. xi + 185; 37 text illustrations. $1, net.

This book is written to urge upon shipbuilders and shipowners the proposition that greater subdivision of the hulls of passenger vessels is needed as a safeguard against wreck from collision. The author of the book, J. Bernard Walker, Editor of the *Scientific American*, cites the famous "Great Eastern," built in 1858, as the first example of the effective division of a ship's hull into watertight compartments. He compares her construction with that of the "Titanic," and records the sequence of events in the loss of the latter vessel.

Mr. Walker further compares warship construction with merchant-vessel construction and shows how the hulls of modern war vessels are divided and subdivided to enable them to endure even the damage done by torpedoes or floating mines without sinking. It is, of course, impossible for commercial reasons as well as considerations of convenience to subdivide a passenger vessel like a warship, but it is possible to provide merchant ships with a double bottom and to carry it far enough up the sides to add greatly to the safety of a ship in case of injuries to her outer skin. It is also possible to carry transverse bulkheads to greater heights and to provide a watertight lower deck, which would limit the rise of water in case a compartment is pierced.

The book is written in a style to interest the non-technical reader; and its purpose is rather to inform the general public as to what should be done to guard against a repetition of the "Titanic" disaster than to give information to engineers familiar with marine matters.

One is inclined to question the author's declaration that the "Great Eastern" was the safest ocean liner ever built. Safety of a vessel at sea is made up of many diverse elements, of which effective subdivision of the hull is only one. Also the title chosen for the book, "An Unsinkable 'Titanic'," is, it seems to us, unfortunate. No ocean-going vessel is unsinkable. It was the fallacious idea that the "Titanic" itself was unsinkable which led her officers to drive her at high speed through a dark night even though the sea ahead of them was known to be dotted with floating ice. After that terrible object lesson as to the dangers of false ideas of security, we should hear no more of unsinkable ships.

A Needed Reform in Teaching Physics

THE TEACHING OF PHYSICS FOR PURPOSES OF GENERAL EDUCATION—By C. Riborg Mann, Associate Professor of Physics, the University of Chicago. New York: The Macmillan Co. Cloth; 5¼x8 in.; pp. 304. $1.25, net.

This book is a quiet but severe arraignment of prevalent methods of teaching physics in American high schools—methods which have developed along with the domination of the public schools by colleges rather than by industries, notwithstanding the fact that 90% of the high school students go immediately into some industrial activity and barely 10% go first to college. Nearly all courses in high-school physics have become too abstract and mathematical and are leading the pupils to "absorption" methods of satisfying fixed college entrance requirements instead of developing ability for the scientific attack of daily physical problems.

The author first outlines the amount and character of instruction in physics now required of high schools so that their graduates may enter college. He traces the transition from the very interesting and useful "natural philosophy" of early American schools to the present presentation of unnatural, impersonal and nonutilitarian (to the 90% of students) "laws" which are to be accurately "verified" by use of laboratory equipment.

The author's second step is to trace the pedigree of modern physics. He fully discusses the claims of the Greek philosophers, particularly Aristotle, to being the fathers of modern science. Of course, he discards all such claims on account of the introspective nature of Greek philosophy and its demand for immediate and complete explanations of phenomena. The true parents of modern science, the author picturesquely tells us, are democratic Germanic industry, and the innate emotion of wonder; this offspring is described as the result of the second marriage of that spiritual lady after the death of the lazy and aristocratic gentleman "ancient physics."

After this, the author analyzes the actual methods of true physics and shows how wrong are the present attempts to cram abstract generalities and cut-and-dried quantitative measurements down the mental throats of present-day pupils—attempts which actually prevent giving them that highly desirable ability of concrete investigation, deduction and generalization which constitute what we call the scientific attitude.

Up to this point the book is destructive in its criticisms, but from here on it is decidedly constructive. The teacher is advised to bring the instruction at first very close to the daily life of the pupils in order to arouse in them the spirit of wonder (not mere curiosity), and to lead them gradually to acquire a conscious notion of what constitutes a scientific attack—"suspended judgment, open-mindedness, impartial observations, seeking all the facts and the just weighing of evidence."

The author recommends approaching the inter-relations of phenomena through the common factor of work and energy, and he urges every possible attempt at simplicity and unity throughout the course. In planning laboratory work he would cut out "making the wheels go round to have a fact made concrete." He would have laboratory work fill the same function in elementary as it does in advanced studies—of securing information needed in solving a problem. In short, to vitalize the teaching the instructor has to create for his pupils an ambiguous situation which stimulates thought and demands measurements or experiments.

Limitations of space prevent discussing the book more in detail. But before closing, it should be noted that the needs which are shown for high schools exist to a very great extent in all our colleges and even in our technical schools—wherever students are, for the first time, being seriously introduced to the realms of physical science. On that account teachers of elementary physics everywhere need humbly to take to heart the criticisms and suggestions of that group to which the author belongs.

Reinforced Concrete Design

Reviewed by LEWIS J. JOHNSON*

REINFORCED CONCRETE—Mechanics and Elementary Design. By John P. Brooks, Director Clarkson School of Technology; Formerly Associate Professor of Civil Engineering, University of Illinois. New York and London: McGraw-Hill Book Co. Cloth; 6x9½ in.; pp. x+220; 87 text figures. $2, net.

This is a condensed, well-balanced work at a low price that should serve a good purpose. While it evidently is not intended to supplant such larger and more comprehensive works as Turneaure and Maurer, it is excellent as far as it goes and it goes far enough to meet the needs of ordinary technical-school instruction and more too.

It presupposes a good working knowledge of mechanics and resistance of materials and is thus enabled to cover its ground in five concise chapters, devoted respectively to history; properties of the ingredients of concrete; significant tests; analysis of stresses in rectangular and T-sections; continuous beams, and columns; and elementary design.

The chapter on design covers 84 pages and naturally is the strong feature of the book. It is based on the report of the Joint Committee—here wisely reproduced nearly in full—and may be said to reflect accurately the best established practice of the day. The structures treated in detail are T-beams, retaining walls, arches by graphic and algebraic analysis, beam and girder floors, and hollow dams. Chimneys, tanks, culverts and minor structures are omitted.

The book is particularly strong in the fullness and clearness with which the illustrative designs are worked out. This is specially the case regarding retaining walls to which 19 pages are given to good purpose.

Barring occasional typographical errors to be expected in a first edition, the book is attractive and thoroughly creditable to all concerned.

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The raising of the wreck of the battleship "Maine" from its 12-year berth in Havana Harbor presented a problem of the highest engineering interest. A number of schemes were submitted to the engineers of the United States Army, to whom was deputed the task of raising the vessel, but the one finally adopted was originated by one of the officers of the corps, Major Ferguson. The readers of Engineering News are familiar with the difficulties involved in the work and with its progress to a successful completion last March when the main part of the hulk was towed to sea and sunk in deep water.

Those engineers who have followed the periodical references to this work in ENGINEERING NEWS will be interested in a complete description of the entire process, which has recently been issued by the Lackawanna Steel Co. as bulletin No. 102. This description is a handsomely illustrated booklet of 40 pages, which describes in great detail the history of the sinking of the "Maine" and the progress of the work toward its final removal. The company which publishes the booklet is interested in the matter because it furnished the steel piles which were used to form the large coffer-dam surrounding the wreck, but this connection in no way detracts from the very interesting and correct description which they have prepared. The type of coffer-dam was quite novel, and it is possible

that it may be used in a number of somewhat similar cases so that a study of its behavior in this initial use should serve to illustrate future possibilities.

Publications Received

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. The amount of postage necessary can be estimated approximately from the stated size of the book or pamphlet and the number of pages it contains. Reprints of papers read before engineering societies and printed by the authors for private circulation can often be obtained without cost by addressing the author, whose name and address is always given when known. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of a reprint of a society paper to the author of the paper. The stated American prices of foreign books are based on 40 cents per shilling and per mark for British and German books, respectively, and 80 cents per franc for French books, the extra allowances being for importation costs.]

THE ALASKA MINING INDUSTRY IN 1911 AND RAILWAY ROUTES IN ALASKA—By Alfred H. Brooks. Advance chapter from Bulletin 520, "Mineral Resources of Alaska, 1911." Washington, D. C.: Pub. Doc., U. S. Geological Survey; Geo. Otis Smith, Director. Paper; 5¾x9 in.; pp. 90; 4 plates (one in pocket).

AMERICAN MACHINIST GRINDING BOOK—Modern Machines and Appliances, Methods and Results. By Fred H. Colvin and Frank A. Stanley, Associate Editors "American Machinist," Members A. S. M. E. New York and London: McGraw-Hill Book Co. Cloth; 6x9¼ in.; pp. ix + 383; 286 illustrations; 36 tables. $3, net.

THE CITY THAT WAS—By Stephen Smith, A. M., M. D., L. L. D., Commissioner of the Metropolitan Board of Health, 1868-1870; Commissioner of the Board of Health of New York, 1870-1875. New York: Frank Allaben, Buckram; 5¼x8 in.; pp. 211; 27 text figures. $1.25, net.

ELEMENTS OF DRAWING—By George F. Blessing, M. E., Ph. D., Professor of Mechanical Engineering and in charge of Engineering, Swarthmore College; and Lewis A. Darling, E. in M. E., Engineering Department Remy Electric Co., formerly Assistant Professors in Machine Design, Cornell University. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 6x9¼ in.; pp. xviii + 193; 151 text figures. $1.50, net.

FREIGHT TERMINALS AND TRAINS—Including a Revision of Yards and Terminals. By John A. Droege, Superintendent, Providence Division, N. Y., N. H. & H. R.R. Co. New York and London: McGraw-Hill Book Co. Cloth; 6¼x9½ in.; pp. vii + 465; 208 text figures. $5, net.

THE GIST OF THE SUPREME COURT DECISION IN THE DICK PATENT CASE—And of the Proposed Patent Law Amendments. By Gilbert H. Montague, of the New York Bar. Reprinted from "The Engineering Magazine," May-June, 1912. New York: The Engineering Magazine. Paper; 7x10 in.; pp. 21.

HANDBOOK FOR HIGHWAY ENGINEERS—Part I. Theory of Design. Part II. Practice of Design and Construction. By Wilson G. Harger, C. E., First Assistant Engineer, New York State Department of Highways; Assoc. M. Am. Soc. C. E., and Edmund A. Bonney, Chief Draftsman, Division No. 5, New York State Department of Highways. New York and London: McGraw-Hill Book Co. Leather; 4x7 in.; pp. 493; 74 text figures; 67 tables. $3, net.

THE HYDROMETALLURGY OF COPPER—By William E. Greenawalt, C. E., B. S. Part I: Roasting. Part II: Hydrometallurgical Process. New York and London: McGraw-Hill Book Co. Cloth; 6¼x9½ in.; pp. x + 504; 112 text figures. $5, net.

INDUSTRIAL COMPETITION AND COMBINATION—Part I: The Effect of Industrial Combinations on Labor Conditions. Part II: Competition as a Safeguard to National Welfare. Part III: The Relation of Industrial Combinations to National Welfare. Part IV: The Policy of Great Britain, Canada and Germany as Compared with That of the United States with Reference to Industrial Combinations. Part V: The Effect of the Sherman Anti-Trust Law on the Business of the Country. Part VI: The Elements of a Constructive National Policy with Reference to Industrial Combinations. Many authors. Being Volume XLII of The Annals of the American Academy of Political and Social Science, July, 1912. Philadelphia, Penn.: The Academy. Paper; 6½x9¾ in.; pp. viii + 384. Issued bi-monthly. $6 per year; $1 per number.

THE INFLUENCE OF WASTE LIQUOR FROM SULPHATE OF AMMONIA PLANTS ON THE PURIFICATION OF SEWAGE—By G. J. Fowler, D. Sc., E. Ardern, M. Sc., and W. T. Lockett, M. Sc. Reprinted from the "Journal" of the Society of Chemical Industry, Manchester Section, May 31, 1912. Manchester, England: Dr. G. J. Fowler. Paper; 8x11 in.; pp. 9.

AN INTRODUCTION TO THE STUDY OF FUEL—A Text Book for Those Entering the Engineering, Chemical and Technical Industries. By F. J. Brislee, D. Sc., Chief Chemist of the British Insulated and Helsby Cables, Ltd; Late Assistant Lecturer in Physical and Electro-Chemistry in the University of Liverpool. New York: D. Van Nostrand Co. Cloth; 5½x9 in.; pp. xxii + 269; 61 text figures. $3, net.

THE LAKES-TO-THE-GULF DEEP WATERWAY—A Study of the Proposed Channel, Terminals, Water Craft, Freight Movement, and Rail and Boat Rates. By William Arthur Shelton, Graduate Student in Political Economy, the University of Chicago. Reprinted from "The Journal of Political Economy," Vol. XX, Nos. 6 and 7. [Chicago, Ill.: The Author, 6146 Greenwood Ave.] Paper; 6x9 in.; pp. x + 133; map. 75c., net; cloth, $1.

MACHINE DESIGN—Hoists, Derricks, Cranes. By H. D. Hess, M. E., Professor of Machine Design, Sibley College, Cornell University, M. Am. Soc. M. E. Philadelphia and London: J. B. Lippincott Co. Cloth; 6x9½ in.; pp. vi + 368; 18 plates and 318 text figures. $5, net.

THE MAIN DRAINAGE OF TOWNS—By F. Noel Taylor, C. E., Member of the Institute of Municipal Engineers; Author of "Civil Engineering Practice." Philadelphia, Penn.: J. B. Lippincott Co. London: Charles Griffin & Co., Ltd. Cloth; 6x9 in.; pp. xi + 313; 350 text figures; 34 tables. $4.50, net.

A MANUAL OF INSTRUCTION IN THE PRINCIPLES OF PROMPT AID TO THE INJURED—Including a chapter on Hygiene and Disinfection. Designed for civil and military use. By Alvah H. Doty, M. D., Late Health Officer of the Port of New York; Late Major and Surgeon, Ninth Regiment, N. G. N. Y. Fifth edition. New York and London: D. Appleton & Co. Cloth; 4¾x7¼ in.; pp. xv + 229; 85 text figures. $1.50, net; postpaid, $1.62.

OELMOTOREN IN VIERTAKT-UND ZWEITAKTBAUART—Von H. Haeder, Ingenieur in Wiesbaden. In two volumes. Wiesbaden: Otto Haeder. Cloth; Vol. I, 5x8 in.; Vol. II, 9¼x8 in.; pp. 646; 460 text figures. Vol. I, 5 marks; Vol. II, 13.50 marks; complete, 18.50. American price, $7.40, net, complete.

ON THE PROPOSED USE OF A PORTION OF THE HETCH HETCHY, ELEANOR AND CHERRY VALLEYS within and near to the boundaries of the Stanislaus U. S. National Forest Reserve and the Yosemite National Park, as Reservoirs for Impounding Tuolumne River Flood Waters and Apurtenant Works for the Water Supply of San Francisco, California, and Neighboring Cities. A Report to James Rolph, Jr., Mayor, and Percy V. Long, City Attorney, San Francisco. By John R. Freeman, Civil Engineer, Providence, R. I. San Francisco, Calif.: Pub. Doc. Buckram; 9½x12½ in.; pp. 401; maps and many halftones.

THE PHYSICAL TESTING OF ROCK FOR ROAD BUILDING—Including the Methods Used and the Results Obtained. By Albert T. Goldbeck, Testing Engineer, and Frank H. Jackson, Jr., Assistant, Office of Public Roads. Washington, D. C.: Pub. Doc. Bulletin No. 44, Office of Public Roads; Logan Waller Page, Director. Paper; 6x9 in.; pp. 96; 20 text figures. 15c. per copy.

DIE PREISBILDUNG IN DER MASCHINEN-INDUSTRIE—By Dr. H. Haeder, Ingenieur. Wiesbaden: Otto Haeder. Paper; 6½x9½ in.; pp. 20; illustrated. Marks, 4; American price, $1.60, net.

RAILROAD OPERATING COSTS—A Continuation of Studies in Operating Costs of the Leading American Railroads. Arranged to include the operations of 1911. By Suffern & Son. Volume II. New York: Suffern & Son. Cloth; 8x11 in.; pp. 144; 64 text figures. $2, net.

ROADS, PATHS AND BRIDGES—By Logan Waller Page, Director, United States Office of Public Roads; President, American Association for Highway Improvement; M. Am. Soc. C. E. New York: Sturgis & Walton Co. Cloth; 5x7½ in; pp. 263; illustrated. 75c., net; postpaid, 84c.

SHOP MATHEMATICS—Part I: Shop Arithmetic. Prepared in the Extension Division of the University of Wisconsin. By Earle B. Norris, M. E., and Kenneth G. Smith, A. B., B. S. (Milwaukee Associate Professors of Mechanical Engineering. New York and London: McGraw-Hill Book Co. Cloth; 6¼x9½ in.; pp. xi + 187; 86 text figures. $1.50, net.

SMOKE—A Study of Town Air. By Julius B. Cohen, Ph. D., B. Sc., F. R. S.; Professor of Organic Chemistry in the University of Leeds, and Arthur G. Ruston, B. A., B. Sc., Science Tutor in the Department of Agriculture, University of Leeds. New York: Longmans, Green & Co. London: Edward Arnold. Cloth; 5½x9 in., pp. 88; 35 text figures. $1.40, net (5/-)

STATISCHE BERECHNUNG VON TUNNELMAUERWERK — Grundlagen und Anwendung auf die Wichtigsten Belastungsfälle. Von Dr.-Ing. Otto Kommerell, Kaiserl. Baurat im Reichsamt für die Verwaltung der Reichseisenbahnen. Berlin: Wilhelm Ernst & Sohn. Paper; 7½x10½ in.; pp. 168; 10 plates and 144 text figures. Geh. 12 M., Geb. 13.50; American price, $4.80 and $5.40, net.

STRENGTH OF MATERIALS—A Text Book for Secondary Technical Schools. By Mansfield Merriman, Member of International Association for Testing Materials. Sixth edition, revised and reset. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 5x7½ in.; pp. vi + 169; 54 text figures. $1, net.

TABELLEN FUER STRASSENBRUECKEN AUS EISENBETONIERTEN WALZTRAEGERN—Von Dr.-Ing. Otto Kommerel, Kaiserl. Baurat im Reichsamt für die Verwaltung der Reichseisenbahnen. Berlin: Wilhelm Ernst & Sohn. Paper; 8¾x13½ in.; pp. 47; 44 text figures. Marks, 6.80; American price, $2.72, net.

TECHNIC OF SURVEYING INSTRUMENTS—A Field Instructor for the Beginner. By J. C. L. Fish, M. Am. Soc. C. E.; Professor of Railroad Engineering, Leland Stanford Junior University. Stanford University, Calif.: The Author. Paper; 4½x8 in.; pp. 32. 25c., net.

THEORY OF STRUCTURES—By Arthur Morley, M. Sc., M. I. Mech. E.; Professor of Mechanical Engineering, University College, Nottingham. New York, London, Bombay and Calcutta: Longmans, Green & Co. Cloth; 5¾x9 in.; pp. xi + 574; 4 plates; 319 text figures. $2.50, net.

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Engineering News

Approval of Plans for Orange-Montclair Sewage Works

The approval by the State Board of Health of New Jersey of plans for sewage-treatment works for Orange, East Orange and Montclair (see note on p. 462, Sept. 5, 1912) makes reasonably sure the relief of those municipalities from the heavy burden of cost which they would have been forced to bear had they entered the Passaic Valley Sewerage District. (See our issue of Feb. 23, 1911.) Had Imhoff tanks and sprinkling or percolating filters been available for adoption by the various municipalities in the Passaic Valley 15 to 18 years ago, it is doubtful whether the trunk sewer then projected and now under way for other cities and towns than those mentioned above would have been adopted; certainly it would not have been had any one foreseen the successive events which have led (1) to the proposed extension of the trunk sewer from Newark Bay to New York Harbor; (2) the subsequent requirement for somewhat extensive sewage-treatment works; and (3) the law suit now pending which is designed to compel still more elaborate sewage-treatment works.

The Ohio Constitutional Amendments

Rarely if ever before have so many state constitutional amendments of interest to engineers and contractors been voted on as was the case in Ohio on Sept. 2. All told, the people voted on 42 amendments, of which all but one (not of interest to engineers, as such) seem to have been carried. Elsewhere in this issue we publish a note summarizing the amendments which promise to be of greatest interest to our readers. These include an extension of the state bond limit for road construction to $50,000,000; authorize cities and towns to own and operate public utilities; permit broad forest and water-power policies to be put into effect; prescribe an eight-hour day on public works; and permit the legislature to establish a minimum wage and sanitary regulations for factories, and to create a fund to compensate workmen for occupational diseases and industrial accidents. It will be noted that many of the amendments give permissive powers which, to become effective, will require legislation. While this means legislative struggles and at least temporary compromises, the signs of the times indicate that sooner or later all these permissive powers will become fully effective, now that constitutional restrictions are removed.

The First Three-Cent Fare Street Railway Line in New York City

A notable event of the past week was the opening of the first three-cent fare street railway in New York City, a line which operates cars over the new Manhattan Bridge. Existing street-railway companies in New York City have fought with every possible legal obstruction the project to establish operations on this three-cent fare line. Without doubt it was not the actual competition of the new company which was feared by the street-railway interests, but the object lesson to the public of the operation of a three-cent fare railway line in the metropolis.

At length, however, no further legal obstacles could be found and as soon as the last court injunction was dissolved, operation of the new line began. More than 3000 passengers were carried on it during the first day of its operation. The old companies are still fighting extensions of the three-cent fare line which will enable it to better serve the public by reaching more nearly to the centers of heavy traffic. It may be confidently predicted, however, that the new line will eventually be able to reach the points it desires, and it is probably true that the older companies have by no means overestimated the influence upon public opinion which successful operation of this three-cent fare line will have.

As has before been pointed out in these columns, New York of all the cities in the United States is the one where a three-cent fare without transfers ought to be the rule on all surface street-railway lines, at least in all parts of the city outside of the suburban districts. What the surface street-car lines need most to do, in their own interest, as well as in the interest of good public service, is to encourage short-distance riding and to discourage the long-distance travel, which latter should be diverted to the subways and the elevated-railway systems. The universal five-cent fare with transfer privileges works in exactly the opposite direction. Further than this, the introduction of the three-cent fare would naturally be accompanied with the introduction of the ticket system as now in force in Washington and Montreal and numerous other cities. The enormous saving in the time of conductors and

avoidance of delay of pay-as-you-enter cars with the ticket system in force would be of great value to the operating company as well as to the traveling public. Where three-cent fares are urged in an ordinary city, there is the more or less valid objection that the long-distance rider gets more than he pays for. In New York City, however, with its obstructed streets, the great bulk of the long-distance traffic gravitates naturally to the subways and the elevated. There are hundreds of thousands of dwellers in New York City who, if they could buy eight tickets for a quarter, would use the surface cars for short distance travel twice as much as they do at the present time.

The Manhattan Bridge: A Monument of Municipal Mismanagement

What would be thought of a business concern, if it should invest $25,000,000 in a plant requiring years to construct, but should make no plans or provisions whatever for the operation of the plant after it was completed, so that three full years would elapse after the plant's completion before its wheels began to turn?

Of course, any business corporation carried on under such unbusinesslike management would promptly find its way to the bankruptcy courts. The City of New York, however, is so great and so wealthy and has such vast resources in its wealthy residents and taxpayers, and its enormously valuable business and real estate interests that there seems to be no limit whatever to the drain that its exchequer will stand. The story of the Manhattan Bridge, however, is a good illustration of how municipal funds may be squandered quite apart from graft or corruption or even inefficiency, as that term is commonly used.

Incidentally it may be remarked that when the construction of the Manhattan Bridge was first projected, it was pointed out in the columns of ENGINEERING NEWS that although the bridge might be an advantageous addition to New York's traffic facilities, the completion of other new bridges and tunnels across the East River made the Manhattan Bridge project one of very doubtful wisdom. The fact that this bridge has stood idle for three years after its completion save for the trifling volume of foot traffic and vehicle traffic over it and without any particular public complaint, is the best proof possible of the correctness of our position at that time.

To return to the story, however, ENGINEERING NEWS' criticism of a dozen years ago fell upon deaf ears. Criticisms which oppose the expenditure of public money generally fall on deaf ears anyway. The city authorities proceeded with the construction of the Manhattan Bridge. The enormous profits made by some, at least, of the contractors who were engaged upon that structure have since become a matter of public record in the courts. Perhaps if the secrets of all hearts were revealed, there may have been other reasons than strict public necessity which induced the city officials of that day to add some twenty-five million dollars to the city debt for the sake of building the Manhattan Bridge.

At any rate the event shows that they were much more anxious to build the bridge than they were to make use of it after it was completed; for as the work dragged along, year after year, with the usual delays and vicissitudes, it seems to have been nobody's business whatever to provide means whereby the bridge could be made use of after its completion. During the three years since the bridge has been ready for the running of cars over it, according to the best of our information, the corporations which control the traffic facilities of New York have been playing "dog in the manger." They have not been willing to operate cars over the bridge on terms involving a reasonable compensation to the city for the use of the structure and much less have they been willing that any other concern should operate cars over it. Thus it has happened that three years have passed between the completion of the bridge and the running of the first cars over it. Even now it can hardly be said to be open for traffic in the full sense, since the "three-cent line," whose operations we have noted above, is so hampered by the opposition of the existing companies that it cannot as yet extend its lines to where it can fully serve the public, whose convenience ought to be the first thing considered.

There is more than one moral in the Manhattan Bridge story. We hear a great deal in these days concerning "city planning," and the term is commonly thought to refer to the use of intelligent design in the laying out of city streets, parks, commercial facilities, etc. In our American cities, however, there is just as great a lack of intelligent city planning, in the carrying on of the ordinary business of the city. The city officials, even those who are most able and well disposed, are more than busy with routine matters and have little time to make broad, general plans for the future development.

There are, indeed, in some of the prosperous and pushing cities of smaller size, especially in the West, some leading municipal organizations such as commercial clubs, boards of trade, or good-government organizations which do undertake to make plans for the city's welfare and for its development and the carrying on of its business with proper foresight for the future. In our greater cities, however, there is absolute lack of any such intelligent policy in carrying on the city's business. This lack may often lead to as great a waste of public funds as results from actual graft.

A New Steamship Terminal at the Port of New York

Much more than ordinary interest attaches to the announcement, in another column of this issue, of a project to establish a new great terminal for transfer between ocean steamships and railways in the port of New York. For several years past a fruitful topic of discussion has been the congestion of traffic at New York City and the consequent high cost and delay in carrying on business.

As a result of the congestion of traffic and the urgent demand for increased facilities for ocean steamships, Commissioner Calvin Tomkins, of the Dock Department, has with the aid of his engineers prepared plans for an elevated-railway system on West St. as a means of facilitating traffic movement, and he proposes to transfer freight cars from the railway terminals on the New Jersey side of the North River to this elevated-railway system over which they would run to terminal stations on Manhattan Island.

In discussing this project in these columns a year or more ago, we urged that the best and most effective cure for congestion of traffic in the port of New York was to take advantage of the unused facilities in outlying parts of the port. Of the enormous mileage of waterfront included in New York Harbor, only a very small percentage is now utilized in any way. It is only on that part of this very small percentage which is located along the North River front of Manhattan Island that traffic congestion has become serious. It is true that there are certain classes of traffic which naturally gravitate to this location and cannot well be accommodated in a more remote quarter. It is also true, however, that for a very large part of the traffic tributary to New York City, or which might be handled through it if it could be done at low enough cost, a different location would be more advantageous and economical.

It is true also that projects for developing outlying terminals at and near the port of New York have been numerous in recent years. The city is now proposing to spend large amounts in developing and making available for ocean steamships the shallow waters of Jamaica Bay, where there is abundant room for development on an enormous scale. The waterfront of South Brooklyn has been developed by the great Bush terminal and by adjacent improvements carried on by the municipality. Every few months renewed rumors are heard regarding the establishment of a steamship terminal at Montauk Point on the eastern end of Long Island. Various cities on Long Island Sound also have dreams of a prosperous future awaiting

them through ocean steamships coming to their wharves to discharge cargo.

There is this comment to be made on any and all of the schemes for creating steamship terminals on any part of Long Island or of Manhattan Island—that the goods transferred at such a point must, if they are destined for the West, be transferred by water to the mainland west of the North River and must then traverse the crowded railway yards of Jersey City before they can start on their journey thither. The same thing is true, of course, of merchandise moving in the opposite direction.

The cost of this additional handling and transfer is a small matter in the case of goods of high value, but it becomes a very important matter where goods of comparatively low value per ton are being handled. Moreover, the delay involved in moving merchandise of any sort from a terminal on Long Island or Manhattan Island to a point where it can start on its journey westward forms a second serious handicap to the movement of traffic in such a channel.

The striking feature of the Montgomery terminal, described elsewhere in this issue, is its location on the mainland of New Jersey far enough away from the crowded railway yards of Hoboken and Jersey City to avoid the congestion that prevails there, and readily accessible to the main lines of the principal trunk-line railways reaching to the West. The estimate made by H. McL. Harding, Consulting Engineer of the enterprise, that on through merchandise traffic to and from the West at least $1 a ton can be saved in handling through this terminal compared with the cost on any terminal located on Manhattan or Long Island, seems entirely conservative.

The chief obstacle to the enterprise at present would seem to be the comparatively limited depth of water in Staten Island Sound, the channel by which vessels will reach this terminal from the lower bay. Its depth is now only 21 ft. at mean low water. While this will be sufficient for many tramp vessels, it is inadequate, of course, for the larger cargo carriers.

It is stated that a board of United States engineers is shortly to consider a project to deepen this channel to 30 ft. at low water. Such deepening would seem to be almost essential to the success of the terminal on a large scale; but with the numerous demands for large expenditures in other parts of the port of New York, it remains to be seen whether this project will receive the sanction of Congress.

It must be remembered that such a measure may naturally be opposed by competing Atlantic ports, such as Philadelphia, Baltimore and even ports in New England and those farther South. However great the merits, from a commercial or engineering point of view, of plans to reduce the cost of handling through the port of New York, the cities which are its chief commercial competitors are well content to have New York continue to do its commercial business over congested piers located on enormously expensive land. The votes of their representatives are not likely to be given to a measure which would put New York in a better position to compete with its rivals.

On the other hand, New York's weight of influence in Congress ought to be sufficient to gain this important aid to its commercial development, for the mere fact that the new terminal is to be located in New Jersey makes it none the less a tributary and integral part of New York as a commercial center.

It is a narrow and a small view that would attempt to limit New York's commercial activity to the shores of Manhattan Island. Such limitation may indeed please the millionaire land owners who control large areas of the borough and naturally welcome any increase in the value of their property brought about by congestion. But so far as the interests of the public are concerned and so far as business transacted in New York is concerned, it is advantageous that its commerce shall be carried on with the least amount of tribute paid in the shape of land rentals. If traffic can be handled on New Jersey lands in the port of New York, worth only $1000 or $2000 an acre, instead of on land in the Borough of Manhattan, worth $100,000 or $200,000 an acre, a larger margin of profit will be available for the buyer, the seller and the carrier.

It is worth noting, too, that this is by no means the only terminal planned to provide an exchanging place between steamship and railway traffic on the mainland of New Jersey. Mr. Bush, the creator of the great Bush Terminal in Brooklyn, is about to construct a great steamship terminal on the opposite side of New York Bay, in Bayonne, N. J., where similar facilities will be made available for the handling of through freight to and from the trunk-line railways as are proposed by the new Montgomery Terminal referred to above.

Still another plan for a steamship terminal in the same general locality is that which has been for years under consideration by the City of Newark. As now planned, however, this is intended rather to meet the needs of the manufacturers of Newark desiring direct importation of their raw materials than to serve the requirements of traffic from ocean steamers to or from inland points.

It may be conceded, of course, that for a steamship cargo destined to be delivered in New York City itself, these outlying terminals on the New Jersey mainland would be less economical than the present facilities in the Boroughs of Manhattan and Brooklyn. The port of New York, however, is to a large extent a gateway for traffic to and from the entire country. As such a gateway the entire country is interested in making the obstructions for passing through it and the cost of that passage as small as possible. The new facilities projected, therefore, are of interest and importance not only to the commercial interests of New York, but to the country at large and appear to be in the line of proper economic development.

The Montgomery Terminal for Ocean Steamships, on the New Jersey Mainland, Port of New York

By H. McL. Harding*

The Montgomery Terminal of the Port of New York is to be located on the New Jersey mainland at the junction of the Staten Island Sound and the Rahway River, and will be the most completely equipped terminal anywhere along the Atlantic Coast. In its initial development there will be 907 acres of land included which have already been purchased, with provision for acquiring in the future nearly as much more.

Of the two principal public terminals in the port of New York, the largest has an area of less than half that of the Montgomery Terminal, and the other only about 200 acres. The next largest has about 30 acres.

This terminal will have a quay wall and pier frontage of over 20,000 ft., or about four miles. Based upon the average transferring capacity per lineal meter of frontage of many European, South American and New York City piers, it should be possible, according to the above, to transfer over 2,500,000 tons per annum.

It is known that as the transferring machinery is improved, the capacity for transference can be increased, and it would be conservative to double the above figures; but this has not been done.

There will be a cubic capacity in the trans-shipment, transfer and transit sheds at the beginning of business of over 13,000,000 cu.ft. There will be berthing capacity at one time for 33 large sized freight steamers, each of a length of 450 ft. This only takes up about 14,000 lin.ft., leaving about 10,000 ft. for smaller ships, barges and lighters.

Embraced within the boundaries of the terminal will be, as shown upon the plan, a basin of 40 acres in extent, affording

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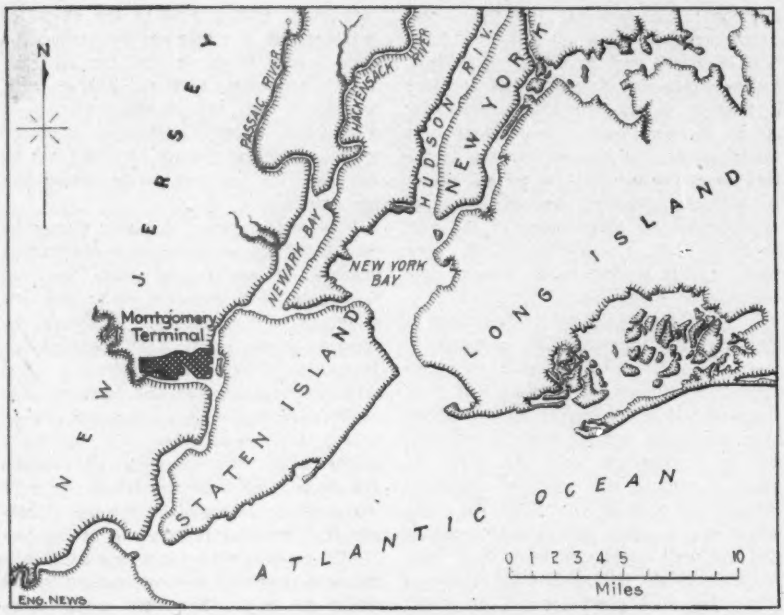

FIG. 1. OUTLINE MAP OF THE PORT OF NEW YORK, SHOWING LOCATION OF PROJECTED MONTGOMERY STEAMSHIP TERMINAL

long quay walls and ample space for the turning of the largest freight ships, as well as a large mooring area, furnished with dolphins and buoys, for barges, lighters, canal boats and fishing vessels.

There is a depth of water in the Staten Island Sound of between 21 ft. m.l.w. and 25 ft. at high water, ample for the freighters above mentioned, as the maximum draft of the above rarely exceeds 21 ft. The width of Staten Island Sound opposite the terminal is about the same as that of the Thames at London, England.

The Sound waterway is dredged and maintained to this depth by the Federal Government, and as some 30,000,000 tons pass through this waterway annually, nearly double that of the Suez Canal, a meeting is to be held in September by the United States engineers to consider increasing the depth to 30 ft., looking to an increase in the size of freight carriers.

The space within the pier slips will be dredged to 25 ft. in the beginning, and the same depth in the Rahway River within the terminal limits, and also in the basin.

The terminal is to comprise all the elements which are now deemed necessary for a successful terminal, the omission of any one of which would endanger its great opportunity to add still more to the commercial supremacy of this great port of New York for the transference or trans-shipment of through or commercial freight. On account of the congestion along the Manhattan waterfront, all new terminals will be of advantage to the whole port.

As to the seacoast state of New Jersey, the advent of such an enormous terminal for through traffic will result in a greater business development than any other movement in the state during the present decade.

The terminal elements will consist of piers, quay walls, both with their respective trans-shipment sheds 800 ft. long by 90 ft. wide, land transfer and transit sheds, each 400 ft. in length and 100 ft. in breadth. The warehouses for long storage and cold storage, for wool, tobacco, sugar, coffee and hemp, as well as those designed for fish, fruit and perishable commodities, will be situated in the reserved portion of the Industrial Section to the west of the Basin, as the demand arises.

In this latter area will be located the industrial lofts, while in the western division will be the homes of the employees of the terminal, and of those factories and industries situated within the Industrial Section. The eastern portion of this western division can be reserved for additional car tracks and manufacturing lofts.

At the head of the piers, a most advantageous position for easy transference, there is along the whole eastern waterfront, the tracks of the Sound Division of the Central R.R. of New Jersey, and through the middle of the terminal area another line of the same railway, and along the western boundary, the main line of the Pennsylvania R.R. Within a radius of a few miles from the end of the Terminal R.R., easily reached by a connecting railway, the route for which has been surveyed, are four trunk line railways, the Baltimore & Ohio, the Lehigh Valley, the Philadelphia & Reading, and the Erie.

Through the center of the terminal will be the tracks of the Terminal R.R., 3½ miles in length. There will be sidings, loop tracks around the whole waterfront of the terminal, amounting with the storage, receiving, classification and storage tracks to about 30 miles in length as needed, with room for a still greater trackage in the space reserved for this purpose. Dray areas have been provided, with platforms, in a number of locations.

From this condensed description it will be seen that provision is made for the following essential elements of a terminal, namely:

Piers and pier sheds, transit, transfer and trans-shipment sheds, warehouses for different purposes and commodities, railway tracks and platforms, dray areas and platforms, industrial and residential sections all within the terminal limits, forming one complete whole, unified by means

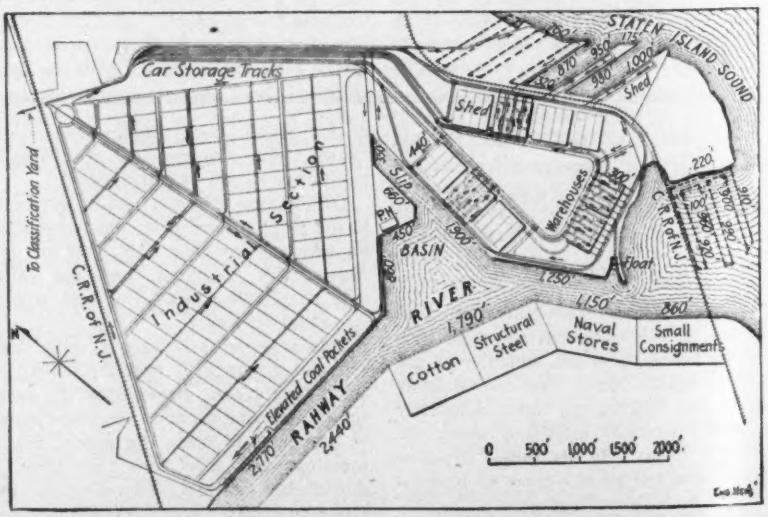

FIG. 2. GENERAL PLAN OF PROJECTED MONTGOMERY TERMINAL

of the latest types of far and cross-transferring machinery.

There will not be the customary handling and rehandling by manual labor. After the first handling, machinery will do the rest, guided by skill and intelligence, with overhead conveyors, tractor and trailer hoist trains, using movable cross and loop tracks.

At the recent International Congress of Navigation, held in Philadelphia, it was voted to have upon the program of the next Congress, substantially, that it should be possible to serve directly by machinery all parts of a terminal, that is, all cubical space, including tiering, without rehandling by manual labor.

Above all, the terminal has been planned so as to provide for the most rapid and economical transference of through shipments. All the latest types of cargo-handling mechanism will be installed, not merely for bulk material, but for cargoes of miscellaneous merchandise.

It is estimated, that by this direct transference between vessel and rail by mechanical methods, by the elimination of lighterage, by less detention of ships for loading and discharging, by lower terminal expenses in contrast with the very nigh pier and quay rentals of New York, that there will be a saving of over a dollar a ton at this terminal for through or Western freight over cost of handling through the Manhattan or Brooklyn terminals.

It is hoped that this terminal will be ready for business by the time the Panama Canal is opened.

The writer is acting as consulting engineer for the enterprise.

Gaging Minnesota Streams in Winter*

By W. G. Hoyt†

The methods employed and the results obtained in hydrometric work in Minnesota during the winter of 1911-12 are described. A notable feature of the work was taking current meter readings through holes cut at intervals across the streams through the ice. Office as well as field work is described. A table shows for many streams of Minnesota the minimum run-off in the summer of 1910 compared with that of the winter of 1911-12.

Until recently a pronounced defect has existed in stream-flow data, due to the lack of records covering the winter period in localities where ice conditions prevail. During the past two years the Water Resources Branch of the U. S. Geological Survey has undertaken to remedy this defect in its records, and has succeeded to a large extent, especially in the states of Minnesota and New York.

The problems presented in winter-stream gaging are interesting and are well illustrated in the following discussion of the work and results of the winter of 1911 and 1912 in Minnesota.

Winter conditions may be briefly classed under the following: (1) Complete ice cover which may be wholly or partly supported by the flowing water. (2) Incomplete ice cover. (3) Slush and anchor ice which may exist in connection with the first and second conditions.

*Permission for publication given by Director of U. S. Geological Survey.

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Any of the above conditions will, as a rule, disturb the relation of gage heights to discharge even though the ice condition is not at the measuring point or gage section. The value of gage heights under such conditions is small. They do, however, set the limit of maximum flow and tend to show any breaks in the continuity of the flow and must, therefore, be taken. Results of discharge measurements carefully made are the base data upon which the estimates must be made.

The following is a brief outline of the general methods, both field and office, which have been used in carrying on the work:

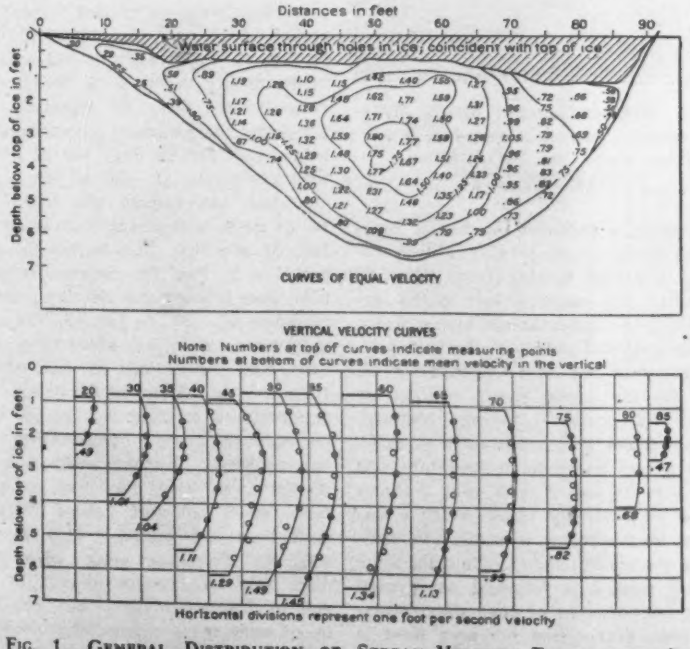
Distances in feet
Depth below top of ice in feet
Water surface through holes in ice, coincident with top of ice
CURVES OF EQUAL VELOCITY
VERTICAL VELOCITY CURVES
Note Numbers at top of curves indicate measuring points
Numbers at bottom of curves indicate mean velocity in the vertical
Horizontal divisions represent one foot per second velocity

FIG. 1. GENERAL DISTRIBUTION OF STREAM VELOCITY FLOWS UNDER ICE

FIELD METHODS

As soon as ice forms on the streams the observers are instructed to discontinue daily gage readings and to take only two readings a week. The observer records the day, month, time of day, gage height to water surface, average thickness of ice at gage section, average distance water surface to top of ice, condition of ice below gage, and also makes a sketch showing the general conditions in the vicinity of the gage. The best results are obtained when the observer is furnished with an ice chisel and ice measuring stick. The most satisfactory chisel is one that can readily be made by a blacksmith, weighing from 6 to 8 lb., made of one piece iron with a 2-in. blade and a handle about 5 ft. long. Commercial ice chisels with wooden handles and notched cutting edges may be used, but they are not as effective. The ice measuring stick which is used to measure thickness of ice consists of a 1x1-in. hardwood stick, 3 ft. long, graduated to tenths, with a 3-in. angle iron fastened to one end so that observers may accurately determine the under surface of the ice. Considerable care has to be taken in instructing the observer if good results are to be obtained.

In addition to the gage heights, discharge measurements have to be made, the number depending entirely upon the stability of the ice and temperature conditions. Discharge measurements should

be made as soon as the ice forms solid enough to hold a man and at intervals ranging from one week to a month apart until the ice breaks up. Discharge measurements are especially needed after any change in condition of flow. The measurements can usually be made by one man using local help in cutting the holes and preparing the section. A knowledge of the character of the stream in the vicinity of the gage during open water is essential if good winter measurements are to be made, as it is difficult to properly locate a good section after the stream is frozen. The section under the ice should be as narrow as possible, with fairly uniform depths and velocities. Holes for the measuring points are cut from 5 to 10 ft. apart, depending upon the width of the section, in a line across the stream. In cutting the hole a sharp axe is used for the first foot, but after this depth the chisel, already described, is found to be more convenient. The holes are cut about 1½ ft. in diameter and should be kept clear of ice cuttings. In cutting the holes care should be taken not to cut through the ice into the water until a few rapid blows will clear the hole. If this is done, a hole can be cut through ice from 1 to 3 ft. in thickness with little splash. After the holes are cut the proceedings for the measurements are as follows:

(1) The distances between the holes are measured with a steel tape and recorded.

(2) The total depth of water, thickness of ice, distance from water surface to top of ice is taken and recorded for each hole.

(3) The meter observations to determine the velocity of the water are taken.

(4) Before and after the measurements the gage height of the water surface is read.

The velocity observations should be made by the 0.2- and 0.8-point method, provided the depth of water under the ice is over 2 ft.; if not, the meter is held at mid-depth and a coefficient is used to reduce the velocity to the mean. Hundreds of observations taken have shown that the mean of velocity taken at 0.2 and 0.8 of the depth under the ice will give the mean in the vertical. Fig. 1 shows the general distribution of velocities under the ice. Vertical velocity curves made under ice conditions differ from the vertical velocity curves under open water conditions in that the under surface of the ice offers much more friction than the air, causing them to draw back at the top. As shown by Table I, the mean of the average velocities at the 0.2 and 0.8 depth give the mean in the section; the coefficient to reduce to mid-depth velocities to the mean in the section is 0.87.

The mean of 161 observations made during the past winter in Minnesota, at different sections and under varying conditions of ice cover, gave a coefficient of 0.86 to reduce the mid-depth velocity to the mean in the vertical. There is, however, a range of from 0.70 to unity between individual observations, so that it is best to always use the 0.2 and 0.8 method, as the mean of the velocities at these two depths is usually the same as that obtained by the vertical velocity curve method. Before taking the velocity observations the computations to determine the 0.2 and 0.8 depth for each hole are made and recorded. The above work is done before the meter is taken from the box.

The velocity observations were made with a small "Price" meter suspended on a rod instead of a cable, the rod being much more convenient to use than a cable. The time was determined by a stop watch, a sufficient number of revolutions being timed to give a true velocity, a period ranging from 40 to 60 seconds. The meter is left in the water while the observations are recorded and then carried swiftly to the next hole. By following the above methods in no case did the meter freeze so as to hinder its perfect working, although measurements were made daily throughout a period when the temperature was from 0 to 30° below zero. Fig. 2 shows a view of conditions under which a discharge measurement is made. In computing the measurements, about the same general method is followed as is used in the computations of open water measurements, except that the area used is the cross-sectional area under the ice.

FIG. 2. MAKING CURRENT METER MEASUREMENTS THROUGH THE ICE, BIG FORK RIVER, BIG FALLS, MINN., FEBRUARY, 1912

OFFICE WORK

As already stated, there is little or no relation between gage height and discharge when ice conditions exist; therefore, any attempt to develop a station rating curve by plotting the results of discharge measurements and gage heights is useless.

The plan followed was to plot a graph, using days as one coördinate and for the other the following: (a) discharge measurements, (b) gage heights to water surface, (c) range in temperature, (d) discharge as determined by applying gage height to open water curve. By the use of these data a hydrograph is drawn, which will represent a fairly accurate estimate of flow. In its construction, the discharge measurements definitely locate points on the curve. The other factors are used for interpolation of the intermediate discharge.

The accuracy of these estimates depends chiefly upon the number of discharge measurements and the stability of weather conditions. In states situated, as is Minnesota, where temperature conditions are fairly uniform during the winter, it is thought that the estimates represent the true flow well within about 10%. Errors in the estimates can often be partially eliminated by making a careful comparison of the runoff at different stations in the same drainage basin. The accuracy of records may also be improved if data can be collected regarding amount of water stored in reservoirs and mill ponds.

CLIMATOLOGICAL CONDITIONS

The winter conditions during the winter of 1911 and 1912 were extremely severe throughout the United States. The period of 50 days, from Dec. 25, 1911, to Feb. 12, 1912, was the coldest period in the history of the U. S. Weather Bureau for the state of Minnesota. At Crookston the minimum temperature was below zero for 49 days out of the 50, with a minimum of −39° on Jan. 11. The maximum temperature was below zero for 21 days, with a maximum of +24 on Jan. 31 and Feb. 12. During the same period at St. Paul the minimum temperature was below zero 34 days, with a minimum of −30° on Jan. 12. The maximum temperature was above zero for 38 days, with a maximum of +32 on Feb. 10, nearly at the end of the period. The temperatures at these two points fairly represent the general conditions throughout the State. Probably nowhere in the district was the maximum temperature much if any above freezing throughout the period. This January was the first one since 1875 when there was no January thaw. At the end of December there was about 12 in. of snow along the northern boundary and a trace in the southern part of the

state. The beginning of February found the state covered with a blanket of snow from 1 to 2 ft. in depth. There was more sunshine than usual; the percentage of the possible amount was about 60. There was very little wind and no disagreeable storms. Aside from the extremely low temperature, the weather throughout the period was ideal. During the past winter the streams froze up between Nov. 15 and Dec. 1, and remained ice covered for a period ranging from 71 days in the southern part of the state to 150 in the northern part, an average throughout the state of 130 days or about 20 days longer than the average for the period covered by records.

TABLE NO. 1—VERTICAL VELOCITY CURVE MEASUREMENTS OF CANNON RIVER AT WELCH, MINN.

Distance from initial point, ft.	Depth under ice, ft.	Velocity from vertical velocity curves—ft. per sec. Mean (a) velocity	½ (0.2 + 0.8)	Mid-depth	Coef. to reduce to mean velocity ½ (0.2 + 0.8)	Mid-depth
20	1.4	0.49	0.49	0.52	1.00	0.93
30	3.0	1.01	1.01	1.18	1.00	0.86
35	3.7	1.04	1.02	1.27	1.02	0.82
40	4.6	1.11	1.09	1.33	1.02	0.83
45	5.2	1.29	1.25	1.57	1.03	0.82
50	5.6	1.49	1.46	1.78	1.02	0.83
55	6.0	1.45	1.45	1.76	0.99	0.82
60	5.7	1.34	1.40	1.50	0.96	0.89
65	5.4	1.13	1.15	1.30	0.99	0.87
70	4.7	0.95	0.94	1.06	1.00	0.89
75	3.7	0.82	0.80	0.87	1.02	0.94
80	2.6	0.68	0.68	0.71	1.00	0.95
85	1.1	0.47	0.51	0.55	0.93	0.86
Average.....					1.00	0.87

Undersurface of ice smooth. River-bed covered with small gravel.
(a) Determined by planimeter from vertical velocity curve.

Results Obtained

During the period from Nov. 1, 1911, to March 31, 1912, 32 stations were maintained. At 29 of these stations solid ice cover formed. Three stations remained partially open, due to high velocity or influence from springs and power plants. At these stations 91 measurements were made under complete ice cover ranging in thickness from 1 to 3 ft., and 34 measurements were made under open water conditions. The cost of these measurements was approximately $12 each, divided as follows: $5 for time, $4 for railroad fare, and $3 for subsistence.

Using the results of these measurements as a base, supplemented by the observers' report cards, climatological data furnished by the U. S. Weather Bureau and data on flow and storage at several power plants, it has been possible to estimate the flow at upward of 40 stations located upon all the principal streams of the state.

Table II gives a general resumé of the results obtained from the work, together with the minimum flow for July and August, 1910,* which shows the importance of winter work in districts where the low water flow occurs during the winter months. This table includes streams in the three main drainage basins of the state: (1) Red Lake or Rainy, flowing into Hudson Bay, (2) Mississippi, and (3) Lake Superior (St. Lawrence). In the table the rivers have been shown in their general order in the basin beginning with the main stream and taking up the tributaries in their regular order downstream. The precipitation records have been compiled from records collected by the U. S. Weather Bureau from about 75 stations in the state.

During the summer and fall of 1910, the majority of streams in the state reached a point of extremely low flow. The flow recorded at that time was probably below the low flow of 1864, which is locally known as an extremely low water year. As shown by the table, the low flow of 1910 was due entirely to the deficiency in the precipitation. This deficiency in the four months previous, ranging from 5.5 in. in the western and northwestern portions to over 10 in. in the southern and southwestern portions of the state.

During the months of January and February, 1912, the streams throughout the state reached a point of low water flow, which was in general below that of the summer of 1910, and this occurred notwithstanding the fact that with the exception of the Red River Basin, the precipitation for the preceding months, from September to December, was equal to and exceeded the normal. In the southern part of the state the excess was over 7 in., yet in this portion of the state the flow was nearly as low as that during 1910. Where the precipitation was below normal (as in the Red River Basin) the marked decrease is very noticeable.

In general, the remarkable low flow

*See article by Robert Follansbee, Eng. News, Vol 65, No. 18.

TABLE II.COMPARATIVE MINIMUM RUN-OFF FOR MINNESOTA STREAMS, SUMMER OF 1910 AND WINTER OF 1911-1912

River	Station	Drainage area, sq.mi.	Precipitation Normal	April-July 1910	Diff.	Monthly flow July or August 1910 sec. ft.	per sq.mi.	Precipitation Normal	Sept.-Dec. 1911	Diff.	Monthly flow Jan. or Feb. 1912 sec. ft.	per sq.mi	Character of flow
Hudson Bay Drainage													
Ottertail	Fergus Falls	1,310	13.70	6.06	—7.64	32.6	0.025	5.92	6.28	+0.36	70	0.053	Natural*
Pelican	Fergus Falls	433	13.70	6.06	—7.64	5.6	0.013	5.92	6.20	+0.28	2	0.004	Natural
Wild Rice	Twin Valley	805	13.25	5.56	—7.69	21	0.026	6.59	5.32	—1.27	3	0.004	Partly controlled
Red Lake	Thief River Falls	3,450	13.50	5.50	—8.00	236	0.069	6.50	5.10	—1.40	4	0.001	Natural
Red Lake	Crookston	5,320	13.08	5.46	—7.62	293	0.055	6.41	5.05	—1.36	28	0.005	Natural
Thief	Thief River Falls	1,010				0	0				0	0	Partly controlled
Clearwater	Red Lake Falls	1,310	11.18	5.43	—5.75	35.7	0.027	5.53	5.43	—0.10	25	0.019	Natural
Rainy	International Falls	14,600				4,540	0.320				4,200	0.288	Controlled*
Little Fork	Little Fork	1,720	14.35	7.90	—6.45	88.4	0.051	7.72	4.84	—2.88	70	0.037	Natural
Big Fork	Big Falls	1,320	14.23	7.49	—6.74	65.3	0.049	6.38	4.88	—1.50	30	0.023	Natural
Vermilion	below Vermilion Lake	507	14.70	8.30	—6.40			8.20	7.30	—0.90	95	0.188	Natural*
Mississippi River Drainage													
Mississippi	above Sandy River	4,510	13.97	7.94	—6.03	1,935	0.425	7.20	5.68	—1.52			Controlled
Mississippi	Anoka	17,100	13.13	7.15	—5.98	3,390	0.198	6.28	7.26	+0.98	2,330	0.136	Controlled
Mississippi	St. Paul	35,700	13.22	7.15	—6.07	3,850	0.108	6.27	9.23	+2.96	2,700	0.076	Controlled
Crow Wing	Nimrod	1,010				140	0.140						Natural*
Crow Wing	Pillager	3,230	13.97	7.00	—6.97	283	0.088	6.14	7.05	+0.91	340	0.105	Natural*
Long Prairie	Motley	973				67.4	0.069						Natural
Sauk	St. Cloud	816	13.02	6.64	—6.38	42.6	0.052	6.00	7.99	+1.99	30	0.037	Natural
Elk	Big Lake	615	13.98	6.70	—7.28			6.53	8.89	+2.36	50	0.081	Natural
Crow	Rockford	2,520	12.85	6.66	—6.19	58.5	0.023	7.21	11.04	+3.83	40	0.016	Natural
Crow So. Fork	Rockford	1,160				3.6	0.003				10	0.009	Natural
Rum	Onamia	414				5.9	0.014				0	0	Natural
Rum	Cambridge	1,160	13.98	6.70	—7.28	84.2	0.073	6.53	8.89	+2.36	70	0.060	Natural
Minnesota	Odessa	1,560	12.79	5.49	—7.30	16.5	0.011	5.25	9.67	+4.42	4	0.0025	Natural
Minnesota	Montevideo	6,300	13.05	8.35	—4.70	72.5	0.012	5.54	9.94	+4.40	15	0.0024	Natural
Minnesota	Mankato	14,600	13.51	7.71	—5.80	253	.017	5.66	10.56	+4.90	250	0.017	Natural
Chippewa	Watson	1,940	13.51	8.01	—5.50	12.0	0.006	5.44	8.69	+3.25	5	0.0026	Natural
Cottonwood	New Ulm	1,190	13.93	9.21	—4.72	9.3	0.008	5.86	12.63	+6.77	15	0.017	Natural
Kettle	Sandstone	823	14.50	7.00	—7.50	71.1	0.086	9.27	10.09	+0.82	90	0.087	Controlled
Snake	Mora	422	14.04	6.34	—7.70	37.5	0.089	8.82	10.50	+1.68	30	0.071	Controlled
Cannon	Welch	1,290	14.06	5.06	—9.00	124	0.096	8.04	14.65	+6.61	310	0.240	Controlled
Zumbro	Zumbro Falls	1,120	14.61	4.54	—10.07	157	0.140	7.68	15.32	+7.64	242	0.174	Natural
Zumbro So. Br.	Zumbro Falls	821						7.68	15.32	+7.64	165	0.201	Natural
Root	Houston	1,560	15.44	4.65	—10.79	322	0.206	8.29	15.88	+7.59			Natural
Roof No. Br.	Lanesboro	647	15.44	4.65	—10.79	134	0.207	8.29	15.88	+7.59	150	0.232	Natural
Cedar	Austin	425	15.43	5.25	—10.18	49.5	0.116	7.87	15.84	+7.97	45	0.106	Natural
Missouri River Drainage													
Rock	Luverne	440	13.80	9.01	—4.79			6.51	11.45	+4.94	12	0.083	Natural
Lake Superior (St. Lawrence) Drainage													
Beaver	Beaver Bay	120									7	0.058	Natural
St. Louis	Thompson	3,420	14.05	9.54	—4.51	549	0.161	7.53	7.54	+0.01	334	0.098	Controlled
Whiteface	Meadowland	442				112	0.253						Controlled
Cloquet	Independence	698				295	0.423				140	0.201	Controlled

*Lakes in drainage basin acting as storage reservoirs.

was, therefore, not due to the lack of precipitation, but rather to the length and severity of the cold period which cut off all water-supply except ground water. The ground water was taxed to its utmost capacity to provide runoff for a period of over a month during which time there was little aid from surface waters. The flow of the ground water must also have been retarded to some extent by the climatic conditions, even though it did not freeze. Had the precipitation been below normal throughout the state, conditions would have been much the same as they were in the Red River Valley, where the low flow was unprecedented.

This work shows that it is practically impossible to determine with any degree of accuracy the flow in the winter months from a study of precipitation and temperature data alone, so that the failure to determine the flow by meter observations means a lack of knowledge of the low water flow and a large degree of uncertainty as to the total runoff and its distribution.

The hydrometric work in Minnesota is carried on under the direction of the Water Resources Branch of the U. S. Geological Survey, in coöperation with the State Drainage Commission, of which G. A. Ralph is Chief Engineer. In the collection of the field data, the writer has been assisted by Prof. E. F. Chandler, of the University of North Dakota, and S. B. Soule, of the U. S. Geological Survey.

First American Congress of the International Association for Testing Materials

The International Association for Testing Materials at its fifth triennial congress in Copenhagen in 1909 resolved to meet in America in 1912 under the chairmanship of Dr. C. B. Dudley, of Altoona, Penn., who at that time was President of the American Society for Testing Materials. After Dr. Dudley's death, Prof. H. M. Howe, of New York, succeeded him both as President of the American Society and as Acting President of the International Association, and it was under his chairmanship that the congress of the International Association was held in New York City during the past week.

This is the first congress of the International Association to be held in America. In effect it represents the first occasion on which the American membership, the largest contingent upon the association's roll, received a recognition commensurate with its numerical importance. In committee representation and other activities of the association America has played a very minor part indeed.

The work of the Sixth Congress may be concisely summarized by the statement that in number of papers it contained, roughly, twice as much as the preceding congress, and in results of work of technical committees it was at least equal to any of the previous congresses. It is necessary to say at this point, however, that the reports of technical committees must, on the whole, be regarded as failures, and that this part of the association's work, which in theory is the most important and most active part, has the appearance of being virtually negligible, both in amount and in importance. The most important technical committees either reported that they were unable to arrive at any results on account of international controversies that cannot be settled, or presented results which were nullified by withdrawal, rejection or re-reference.

At the present congress the Americans were not only represented adequately in the presentation of papers but they also took a prominent part in the discussion of committee reports and in the suggestions made for future work.

As further illustrating the contribution of the American testing engineers to the success of the Sixth Congress, it is to be noted that a very large and active committee was at work for fully a year preceding the congress to make the multifarious arrangements for inviting, receiving and entertaining the foreign visitors; and that, to cover the expenses of the congress, a sum approximating $40,000 was raised in America as a free gift.

INCREASE OF DUES—The membership of the association, now numbering nearly 3000, is insufficient (with the very low annual dues, $2, fixed by the statutes) to pay the expenditures of the triennial congress period. Up to the present all proposals for raising the dues have been strongly resisted by the leading men in the council of the association. Now, however, the state of affairs led to a unanimous conclusion that an increase of dues to double their amount, or $4, be recommended. This recommendation was approved by the congress in its closing session, and becomes now part of the statutes. The change will enable the association not only to pay its expenses throughout the three-year period but also to cover its past indebtedness remaining unpaid.

Officers and Next Congress

The first official act of the congress was to make Acting President Howe the president of the association, an act which was beyond the constitutional power of the governing Council of the association and had, therefore, to be deferred until the congress convened. The congress accepted the invitation of the Czar of Russia to hold the next congress, in 1915, at St. Petersburg, and elected Dr. N. Belelubsky, of St. Petersburg, the president of the association for the next three years. Prof. H. M. Howe was made a life member of the council and Robert W. Hunt the member of the council for the United States. The secretary of the congress is Ernst Reitler, of Vienna, Austria.

Schedule of the Congress

The technical proceedings of the congress were concentrated in the first week of September. The week's work was opened on Monday, Sept. 2, 1912, by a formal reception, in which the American Society for Testing Materials, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Institute of Mining Engineers, acted as hosts. The reception lobby of the Engineering Societies Bldg., 29 West 39th St., New York, was the scene of this event. The congress opened with its first general session on the morning of Tuesday, Sept. 3, and followed with six series of sectional sessions, in each of which the three sections, A, B and C, met separately in different rooms of the Engineering Societies Bldg. Such sessions were held Tuesday afternoon, Wednesday morning, Thursday morning and afternoon, and Friday morning and afternoon. Finally on Saturday morning, Sept. 8, the closing general session of the congress was held.

In the course of the week a well attended boat excursion to West Point was given Wednesday afternoon, Sept. 4; by good fortune this was blessed with fine weather, the earlier part of the week having been unusually dreary for this season of the year. On Thursday evening, Sept. 5, the American Society of Civil Engineers received the foreign delegates in their house at 220 West 57th St., on which occasion Alfred D. Flinn read an illustrated address on engineering activities in New York City. Ample entertainment for the visiting ladies was provided by an energetic ladies' committee throughout the week; some forty ladies accompanied the foreign members in their visit to this country.

Following the real work of the congress a railway excursion, the "Official Tour," was begun on Sunday, Sept. 8, to continue throughout the week. This tour goes to Washington, Pittsburgh, Buffalo and Niagara Falls, inspecting all the important and interesting technical matters at each point that can be crowded into the two days available. A reception at the White House (by the Secretary of Commerce and Labor, acting in the place of the President) on Tuesday, Sept. 10, is the most prominent feature of this tour. From a technical viewpoint the visit to the Bureau of Standards laboratory in Washington, inspection of the laboratories of the Bureau of Mines and the Bureau of Standards in Pitts-

burgh, and a demonstration by the Bureau of Mines at Pittsburgh, are the chief events of the excursion week.

Resolutions

The procedure in bringing resolutions before the congress was prescribed by the Organizing Committee, as follows: Any one could present a resolution to any of the three sections and upon presentation it was referred to a resolutions' committee, which passed upon it, coördinated it with other resolutions or previous action of the association and reported it back to the section for discussion. Upon acceptance by the section, it was referred to the Council for report. The Council could report as it saw fit, but (in theory) was bound to report in some fashion each resolution. Finally the resolution was presented to the final session of the congress and passed or rejected. Many of the controversies over resolutions were settled in the Resolutions Committees and the action before the congress sessions was merely formal. The technical resolutions adopted were as follows:

INTERNATIONAL SPECIFICATIONS

In view of the present difficulties attending the preparation of international specifications the Congress recommends to the Council that the reference to Committee 1a and 1b for the continuation of their work be the collection and dissemination of information in regard to the modifications in the specifications of the different countries; and that these Committees be instructed to present their reports to the Council from time to time and await further instructions as to proceeding with the preparation of International Specifications.

IMPACT TESTS ON NOTCHED BARS

The Congress expresses its appreciation of the very interesting investigations carried out by the Committee 26, accepts their proposals and, having regard to the utility of impact tests on notched bars for ascertaining the properties of metals used for special purposes, requests the Committee to present to the next Congress definite proposals upon the following points:

Height of drop, weight of anvil, method of measurement, form of supports for the test bars, dimensions of the notch for small test bars.

PRINCIPLES OF SPECIFICATIONS FOR COPPER

The Congress unanimously resolves, that the Committee be thanked for their valuable report on the Principles of Specifications for Copper and that they be asked to continue their work, extending it also to the investigation of copper alloys, and to present a further report at the next Congress.

DEFINITIONS OF MICROSCOPIC CONSTITUENTS OF IRON AND STEEL

The Congress resolves that the report of Committee 53 referring to the nomenclature of microscopic constituents of iron and steel be accepted and the definitions be recommended as standard definitions.

CONSTANCY OF VOLUME

That the task of further examining all methods of accelerated tests for the constancy of volume of portland cement be referred to a Committee and that it shall be an instruction to this Committee to invite experiments by various testing laboratories, and also to have some experiments made by an official testing authority in each country concerned.

FINE PARTICLES IN PORTLAND CEMENT

RESOLVED, That Committee No. 30 for determining a method of ascertaining the fine flour in cement be requested to endeavor to ascertain the approximate size to which the individual particles of cement have to be reduced in order for the particles to hydrate completely at short periods.

SO_3 IN PORTLAND CEMENT

RESOLVED, That the Council be requested to appoint a Committee to report at the next Congress regarding the effect of SO_3 in portland cement.

WEATHERING VALUE OF BUILDING STONES

The Congress decides that the different countries be invited to have the method of Hirschwald examined in testing laboratories and that the results be reported to the next Congress.

REINFORCED CONCRETE

That Committee 41 be instructed to report at the next Congress on Methods of Determining the Quality of Concrete and of Reinforced Concrete.

PLASTIC MORTARS

Committee 42 is invited to continue their work in order to obtain a uniform method of testing plastic mortars and to apply this method to the study of the comparison of various standard sands.

REINFORCED-CONCRETE BUILDING ACCIDENTS

With a view to the prevention of accidents and facilitating the acquisition of the requisite knowledge of the properties of materials, it seems advisable that a uniform system of reporting on building accidents should be adopted in the different countries, in the same manner as is already done in the case of accidents to steam boilers. The Congress expressed a desire that Commiteee 41 shall endeavor to organize such an international system of reporting and to present to the next Congress a report on building accidents, collected country by country, together with the deductions made therefrom as regards the prevention of accidents.

FIREPROOF BUILDING CONSTRUCTION

1. That it is advisable in the future investigations of the strength of concrete and of reinforced concrete as used in buildings to obtain reliable data of the effect of fire at high and at moderate temperatures upon these materials.

II. That the data required should refer especially to:

1. (a) Loss of strength during fire.

(b) Loss of strength after a fire (both upon rapid cooling and natural cooling).

2. (a) The value of different aggregates and the proportion of portland cement to the aggregates.

(b) The value of different forms of reinforcement.

III. That tests conducted with the view of obtaining these data in different countries be arranged as far as possible on a uniform basis, the universal standards for fire tests at the British Fire Prevention Committee adopted at an International Congress in 1903 to serve as far as practicable as a basis for the testing conditions, these conditions having also been largely applied in the tests of the Columbia University testing plant at New York and elsewhere.

IV. That the Council of the International Association for Testing Materials create a special subcommittee (under Group B, Cement, Concrete, etc.) to deal with any problems arising out of the foregoing, to be known as the Subcommittee on the Fire Resistance of Concrete and Reinforced Concrete, and that this Subcommittee be requested to report at the next Congress.

PRINCIPLES OF SPECIFICATIONS FOR OILS

That Committee 39 be continued and that the Committee be requested to take up its work as soon as possible.

SOME TECHNICAL EXPRESSIONS

1. The Congress recommends for the total or absolute force the terms:

In French: Force, effort (de traction, de compression, de cisaillement);

In German: Kraft (Zugkraft, Druckkraft, Schubkraft oder Scheerkraft);

In English: Force, load (tension, compression, shear, pull and thrust).

2. The Congress recommends for the forces (efforts) per unit of area:

In French: Tension, pression, cisaillement (tension normale; pression normale, tension tangentielle);

In German: Zugspannung, Druckspannung, Schubspannung;

In English: Tensile stress, compression stress, shearing stress.

The term: Frottement interieur, innere Reibung, internal friction, shall be reserved for designating the tension, parallel to the plane in which gliding occurs, opposing this slipping.

TESTING OF WOOD

Resolved that the question of testing wood in large pieces, as well as the verification of Prof. Tanaka's formula be entrusted to a Commission.

TESTING ROAD MATERIALS

That the Congress be asked to create a Committee for the unification of the method of testing materials for roads and of the nomenclature of such materials, such Commission to work in collaboration with the Executive Bureau of the International Roads Congress.

Opening Session

The opening session on Tuesday morning was presided over by Prof. Howe. After a brief welcome by Capt. Robert W. Hunt, President of the American Society for Testing Materials, an address was delivered in French and in English by Brig.-Gen. W. H. Bixby, Chief of Engineers, U. S. A., on behalf of the President of the United States. This was followed by addresses by Gov. John A. Dix, of the State of New York, and Wm. A. Prendergast, Controller of the City of New York, on behalf of the Mayor. The session closed with the presidential address of President Howe, which was reprinted in part in our issue of last week.

TECHNICAL SESSIONS

As above noted, the technical proceedings of the congress were conducted in three divisions, following the established

subdivision of the International Association: Section A, Metals; Section B, Cement and Stone; and Section C, Other Materials. The entire program included 153 papers and committee reports, which if equally divided would make only 51 papers for each section, or something over eight for each session of the section. However, the section on metals had over half the total number of papers, while Sections B and C had only about 35 papers each. Doubtless for this reason the subject Metals was divided into two parts on Thursday afternoon, simultaneous sessions being held on Steel Rails and on Cast Iron and Special Steel, while during that period Section B held no session. Even with this subdivision of Metals the program of that section was greatly overcrowded throughout the week, some of the sessions of that section having not less than 15 papers. In considering this number the unavoidable difficulties and delays due to the necessity of translating all remarks made in one language into two other languages must be borne in mind, the official languages of the International Association being English, French and German, and it being the universal desire to keep all three languages on an equal footing by providing fully for interlingual translations through the medium of the honorary chairmen and the honorary secretaries of the section.

In this connection it is only justice due to record the names of the most active of the honorary chairmen and secretaries, whose intelligent and industrious service made the tri-lingual deliberations possible. The chief of them were Prof. A. Sauveur (U. S.), A. Saladin (France), Dr. W. Rosenhain (England), Dr. R. Moldenke (U. S.), C. D. Rinald (U. S.), Prof. F. Schüle (Switzerland), M. Gary (Germany), and A. Foss (Denmark).

In the following we will attempt a brief review of the chief subjects of discussion during the Congress week. On account of limitations in space, it will be impossible to give in this issue abstracts of all the papers and discussion, but we will give a portion of the report of each section, reserving the remainder of each section for our issue of next week.

Section A. Metals

Hardness and Mechanical Wear

Tests of mechanical wear were reported by E. H. Saniter (England), and F. Robin (France). In combination the two papers demonstrate that different forms of wear tests do not agree, and wear tests do not agree with hardness tests. Within a given range of material, however, hardness and other mechanical tests may form a useful index of wearing qualities.

Prof. W. H. Warren (Australia) told of the disagreement of wear and hardness tests in the case of wood paving blocks (sandblast tests for wear), and Dr. W. Rosenhain (England) cited the case of copper-aluminum-manganese alloys as giving high wear resistance figures, though having low hardness and moderate elongation.

On hardness, papers were presented by R. Guillery (France) and Capt. C. Grard (France). The former describes some novel testing-machines, including an automatic device for measuring ball hardness and an elastic-limit machine which uses a truncated cone as compression specimen and determines by an indentation hardness test the point along this cone at which the elastic limit is passed.

Impact Testing

Seven papers on impact tests, by G. Charpy, Charles Fremont, and the Testing Laboratory of the P. L. M. Ry. (France), M. Derihon (Belgium), A. Schmid (Switzerland), A. Gessner (Austria) and N. Davidenkof (Russia), represented in part a controversy between the adherents of the Charpy test as favored by the Copenhagen congress of the association and the smaller and somewhat differently formed and treated Fremont test. In particular, Mr. Derihon reports having used the Fremont test regularly for all steel bought or used in his plant since 1904, and having achieved highly satisfactory results with it. The differences in results obtained with two different sizes of testpieces were enumerated by Mr. Schmid, who made thorough tests with two different sizes and found the results concordant except that the larger testpiece gave values 1.44 times those of the smaller. He also found it possible to forge testpieces to shape, getting concordant results 23% higher than machined testpieces. Mr. Charpy, reporting for Committee 26, on impact tests, states that the results with the small standard and large standard testpiece do not agree, and recommends that prior to the next congress the different impact-test machines should be studied and descriptions reported at the next congress, together with results of comparative tests. He also brings out the important point that the relation between impact-test results and service value is not yet fully established and must be investigated by a statistical method.

Two interesting novelties in impact-test machines were described by the P. L. M. Railway Testing Laboratory and Mr. Davidenkof.

Slag Inclusions

Dr. W. Rosenhain (England) and H. D. Hibbard (U. S. A.) presented papers on the subject of nonmetallic or slag inclusions in steel. Mr. Hibbard has coined the word "sonim" for such inclusions, while Dr. Rosenhain prefers the words "slag inclosures." The two papers set forth that much about these foreign substances is as yet unknown. The discussion further emphasized this. The discussion in which E. H. Saniter (England), J. W. Richards (U. S. A.), E. Heyn (Germany), and R. W. Hunt (U. S. A.), participated also indicated that the essential facts concerning slag inclusions are not yet known. Work at the National Physical Laboratory (England) will be undertaken to determine whether oxides are soluble in steel and if so to what extent, though this study is highly difficult. Mr. Heyn emphasized the fact that very minute inclusions are often more dangerous than larger ones, provided they are sufficiently distributed, and gave an example in which a thin layer of an inclusion high in calcium made a distinct plane of weakness in steel. Prof. Richards advocated dead melting of the steel in an electric furnace and holding it one-half to one hour for the purpose of allowing all impurities to separate out, and Mr. Hunt reported that some 5000 tons of rails produced in this way had gone through the past winter without a single fracture.

Corrosion

Corrosion of iron and steel was treated by three papers by Lieut.-Comdr. F. Lyon, U. S. N.; H. Baucke (Holland), and F. N. Speller (U. S. A.). Lieut.-Comdr. Lyon has worked out a method for testing the relative corrodibility of iron in aqueous solutions, by using a series of dilute solutions of a given salt of successively increasing concentration and determining the concentrations at which general corrosion changes into local corrosion and at which local corrosion disappears. The smaller this range the less corrodible is the metal, he finds. Mr. Speller reviewed the recorded experiences on the relative corrodibility of wrought-iron and soft-steel water pipes in the United States and concluded that there is no evidence to show that steel pipes corrode any faster than wrought-iron pipes. The paper of Mr. Baucke (Holland), who cited cases where in his opinion the action of etching agents or electrolytes enlarged cracks and produced new cracks in metal which had been strained, was discussed by Dr. Rosenhain (England) and Mr. Heyn (Germany), both of whom raised serious doubt whether the phenomena observed by Mr. Baucke were correctly explained by him. Mr. Baucke claimed that the action of electrolytes on strained metals produced a tendency to recrystallization which he looked upon apparently as an evidence of fatigue. P. Kreuzpointner (U. S. A.) stated that the tests of old boiler metal on the Pennsylvania R.R. for many years showed that all defects could be traced back to mechanical defects in the original working of the metal. Prof. Wm. Campbell (U. S. A.) discussed the bearing of the electrolytic theory on corrosion, pointing out that

even a uniform metal such as brass, that is, brass containing only one constituent, will pit through the whole thickness, under circumstances where local electric potential differences could hardly exist, and that in iron the pitting continues even after the small local impurity or segregated spot has corroded away. Gen. William H. Bixby (U. S. A.) described the conditions found on the wreck of the "Maine" when it was uncovered last year. Here it was found that all parts which were covered by the harbor mud, a kind of sewage deposit, were perfectly preserved and rusted only after this mud was removed and they were exposed to air. E. Heyn, discussing the corrosion of wrought iron and steel, remarked that corrosion is in his experience practically uninfluenced by small differences as to impurities contained and that a parallel corrosion test between two pieces of iron will show one or the other metal better according to the time at which the experiment is stopped, the metals often alternating many times in excellence in the course of a long-time test. Differences in composition (differences between pure and impure metal) are felt only during the first six hours, whereas after that time the behavior of pure and impure metal is substantially the same. H. M. Howe and R. W. Hunt (U. S.) and others also discussed the papers on corrosion.

Two papers on steel pipe were presented in connection with the papers on corrosion. Charles Fremont (France) described a method of applying his notched-bar impact test to rings cut from steel pipes. A. V. Karsten (Denmark) discussed some criticisms that had been raised against the Danish standard specification for pipes.

International Specifications for Iron and Steel

Committee 1, on the subject of International Specifications for Iron and Steel, which in one form or another has been working on its subject for over a dozen years past, presented a very lengthy report, which in substance set forth that the German and English manufacturers have decided that it is premature at present to attempt to prepare specifications. The committee presented this also as its own conclusion. As a result of this report and discussion of the subject between interested parties immediately prior to the meeting, the matter was not brought up for discussion in the technical sessions, but a resolution was presented directing the committee to continue work in collecting information as to changes in the various national specifications, without, however, proceeding to formulate international specifications. The resolution is noted with other technical resolutions earlier in this report.

Full-size Testing

Prof. G. Lanza (U. S.) presented a collection of statistical information on large-size testing-machines and testing of full-size or large-scale pieces in the United States. The paper showed that a large number of machines of 400,000-lb. capacity or over is at present in use in this country, the majority of them, however, having been put into service in the last few years. The subject of locomotive testing (on testing stands and in road tests) was also reviewed in connection with strength testing.

Endurance Testing

Six papers on endurance testing were presented. T. E. Stanton (England) described the investigations made at the National Physical Laboratory, Teddington, on the resistance of metals to alternating stresses. This included ordinary alternating-stress tests (rotary bending tests) and alternating-impact tests. It is found that rapidity of alternation does not influence the result. Alternating-impact tests do not agree with single-blow impact tests. Discussion by Dr. W. Rosenhain (England) indicates that in tests by Stanton (using a bar notched in the middle) if the blows were heavy the results would approximate those of ordinary impact tests, while if the blows were light the results would be near to those of the ordinary rotary-bending test. O. Boudouard (France) described a new method of making endurance tests, by measuring the damping of vibrations induced in a bar of the metal; the vibration leads to rupture if sufficiently prolonged. In a series of tests of iron and carbon steel the number of vibrations for rupture ranged from 9000 for hardened crucible steel of 1% C. to nearly 3,000,000 for the same steel tempered.

J. O. Roos (Sweden), in two papers on endurance tests of machine steel, discussed the general factors of rotary-bending endurance tests and the relation of endurance to resilience, with the conclusion that resilience and endurance do not always agree, and that in selecting material for machine parts greatest attention must often be paid to endurance. He also described an impact-endurance test on a cantilever beam, two hammers striking the free end on opposite sides alternately. In this form of test the extreme fiber stress was computed assuming that there was no loss of energy locally, and the number of repetitions at rupture was plotted on an abscissa of fiber-stress. In a certain series of tests a curve was obtained practically identical with the curve for the ordinary rotary-bending endurance.

J. B. Kommers (United States) in two papers presented a method worked out at the University of Wisconsin for an accelerated endurance test. This consists in bending a cantilever testpiece to a deflection beyond its elastic limit, alternately in one direction and the opposite. The author claims that this gives results which are strictly proportional to an endurance-test result obtained inside of the elastic limit. He further proposes a form of test based on these experiments and suggests standard conditions for such an accelerated endurance test. The method depends on a computation of the equivalent fiber stress in bending beyond the elastic limit. Henry Souther (U. S.) discussed the paper briefly, giving the opinion that it has little practical value because in service few materials are strained beyond the elastic limit.

[A continuation of the report of Section A will appear in next week's issue.]

Section B. Cement and Stone

Fine Particles in Cement

Four papers were presented covering this general subject; three upon the methods and effect of air separation, and one on the effect of the smallest particles of cement on its strength. M. Petersen (Denmark) stated as a result of experiments that for ordinary compression tests, where no great accuracy is required, sieve sifting is sufficiently accurate, but for accurate tests air sifting should be specified. He also reported that in very fine grinding the amount of medium material is little changed, where the fine material increases and the coarse material decreases. For normal consistency the percentage of water required increases with the fineness, and the tensile strength increases, though irregularly, and the compressive strength increases markedly and regularly with the finer particles.

Prof. Gary (Germany) reported for Committee 3) that tests to determine whether the Gary-Lindner, or the Petersen, air-sifting process should be adopted had resulted in no definite proposal. R. Feret (France) reported on an experimental study of air sorting to determine controlling conditions. He stated that the size of the particles carried through depends on the atmospheric pressure and velocity of the air current, which latter can be regulated at the exit end of the separator. He stated that further study must be made of the apparatus before any definite report can be made upon it.

The fourth paper, by F. Schüle and H. de Gottrau (Switzerland) was on the value of the finest flour in portland cement. Tests were made on material separated by the Gary-Lindner apparatus. It was found that with increasing fineness, the calcium sulphate percentage and the loss on ignition increased, and the particles seemed to be separated not only by size but by specific gravity, so that the method does not enable fine grinding to be tested fully. It was found that rapidity of set is increased by fine grinding.

The only discussion on these papers was by Messrs. Schüle, Gary and Feret, who amplified their printed papers.

Strength of Cement

A paper by E. Candlot (France) criticized adversely all specifications for cement which call for progressive increase in strength between 7 and 28 days, on the ground that this leads to the production of low early strength, an undesirable feature, and also because it is quite probable that a very strong cement may not show a progressive increase between these two periods.

In the discussion, W. C. Hanna (U. S. A.) presented a series of tables showing that retrogression in tensile strength is due to a number of causes, among which are differences in percentage of mixing water, fine grinding, aging, different methods of test, brittleness of old briquettes. He supported Mr. Candlot's contentions. F. Schott (Germany), Bertram Blount (Great Britain), A. Dyckerhoff (Germany), M. Gary (Germany), all brought forward arguments in favor of Mr. Candlot's paper. It was then brought up that the paper related merely to tensile tests and not to compression tests, because in countries where compression tests are used there is only a 28-day period required, except for a preliminary 7-day compression test, which may be demanded for purposes of predicting the future strength, but which has no rejection qualification.

E. G. Coker (Great Britain) presented a paper which gave the result of some tests to determine the ratio of maximum to mean throat stress in the three chief forms of cement briquettes—English, American and continental. The analysis was made by the method of polarized light effects in transparent bodies under stress and was applied to celluloid models of briquettes. The ratio was found to be 1.75 for the English, 1.70 for the American and 1.95 for the continental briquette. The author concludes from this that different results would be obtained from tests of the different types of briquettes. There was no discussion.

Puzzolanic Admixture to Portlind Cement

A. Poulsen (Denmark) presented a paper describing the admixture of diatomaceous earth to act as a neutralizing agent of the liberated lime in portland cement. This diatomaceous earth has the opposite effect to ordinary silica in that it generally increases the strength of the mortar rather than decreases. He presented a number of tables showing tests of this compound and diagrams to be used in determining the amount of earth to be mixed in with the portland cement. A number of discussors raised the question whether the increase in strength shown in Mr. Poulsen's tests was not due to the extra fineness that the material received in its second grinding. Edward Duryee (U. S. A.) brought before the meeting a number of tables and diagrams showing the effect of various puzzolanic admixtures used in the Los Angeles aqueduct. Mr. Duryee has treated this subject in several recent issues of Engineering News. The question was raised whether the specimens reported by Mr. Poulsen were stored in water or in air, and it was stated by W. C. Hanna (U. S. A.) that puzzolanic cements in 1:3 briquettes often show remarkable strength when stored in water, but poor strength when removed from water and seasoned in air. Apparently, when stored in air the water evaporates before chemical action can take place. Mr. Poulsen, though present, did not answer the questions raised.

J. Y. Jewett (U. S. A.) reported upon the tests of cement, concrete, sand and stone by the United States Reclamation Service. In the discussion the main question raised was the effect of alkali on portland cement. Richard L. Humphrey (U. S. A.) stated that the destruction of this nature which has occurred in this country has been confined to the Black Hills, where there is an alkali, a mixture of sodium and magnesium sulphates, which seriously affects some concretes, but when the concrete is dense the destruction seems to be very little. Probably there is some chemical destruction, but generally the action is physical, due to the crystallization of the salts drawn into the concrete by capillary attraction.

Tests for Constancy of Volume of Cements

Standard tests to determine the constancy of volume of cements have been the subject of a long controversy before the International Association for Testing Materials. Toward the end of 1902 a committee was appointed to investigate the subject and in the early part of 1903 was convened. The program was then drawn up and distributed to all members of the committee. In the following year much work was done by the members of the committee, and a report presented by all members but the Germans, who apparently did not take part in the investigation. A report was finally presented to the Copenhagen Congress in 1909 recommending the adoption of the so-called Le Chatelier test, which provides for the measurement of the increase in volume of a testpiece after submission to boiling water. This report was adopted by the Copenhagen Congress with the German members of that congress dissenting. It may be remarked in passing that the German standard specifications require only a cold-water test for soundness of cements.

Four papers on the subject were presented to the present congress. The first, by Bertram Blount (Great Britain) stated that, although some cement may fail to meet the accelerated tests for constancy of volume and yet be sound, no case has been found in the writer's experience where a cement which stood the test proved unsound later. Since the Le Chatelier test was introduced in England there has been no difficulty in obtaining cement that easily meets the test. Mr. Blount concluded that the international adoption and use of such a test is of the highest value.

In direct opposition to Mr. Blount's paper, Max Gary (Germany) stated in a paper that a full study of the subject of soundness tests by the German Association of German Portland Cement Manufacturers has revealed no cement which proved unsound in use after passing the standard cold-water test, while the boiling test rejected many cements which proved wholly sound in use. Since the Copenhagen Congress comparative tests show that the Le Chatelier test does not give concordant results in different laboratories, and that the material and make of the apparatus influence the result. Prof. Gary stated that the German cements do not fear the Le Chatelier test, as 83 out of 88 were found to pass the test, but, since the test may be misleading and since it may throw out perfectly good cements, he proposed that the action of the Copenhagen Congress be rescinded and that a new committee be appointed to discover an accelerated test for soundness.

F. Schüle (Switzerland) read a paper in favor of the boiling test, which is a standard in his country for cement used in dry exposure. Out of 2200 portland cements tested from 1893 to 1902, the cold-water test rejected 9, the boiling test rejected 193, and of the whole lot 129 proved unsound by 1908. From 1903 to 1908, out of 1737 cements tested, the cold-water test rejected 7, the boiling test 84, and 44 proved unsound by 1910, of which thirty-five had been rejected by the boiling test.

J. Bied (France) in a paper stated that in 20 years the Le Chatelier test had given rise to no objection in French practice. Experiments concerning the variations caused by difference in make, age and wear of the needles showed that these factors as well as the time elapsed between the immersion in hot water affect the results of the Le Chatelier test. He recommended that the time, the details of the needles and their limited length of use be standardized.

The discussion on this subject was so lengthy as to require extension into the next day's session. There was, however, no new information brought forward beside what was contained in the papers. The fundamental opposition to the Le Chatelier test seems to be twofold. First, against the use of the Le Chatelier needles as a method of determining variation in volume, and, second against

the submission of the testpieces to boiling water or steam. The German contingent were opposed to the test on both these grounds. The American members are in favor of a hot-water test, but not the use of the Le Chatelier needles, and the French and English representatives were in favor of the Le Chatelier test *in toto*. The opposition to the Le Chatelier needles seems to be founded on the difficulties in their operation. The opposition to the use of hot-water tests seems to depend on the fact that it throws out a number of cements that will later prove sound. In opposition to this latter contention, the proposers of the hot-water test claim that it serves the very useful purpose of eliminating all cements that are unsound.

Although at the beginning of the congress there seemed to be prospect of an acrimonious discussion on the matter, the members of the various countries finally came together in a compromise resolution which provided that a committee be appointed to investigate the matter further and report at the next congress. This resolution is printed in the list of resolutions earlier in this article.

[A continuation of the report of Section B will appear in next week's issue.]

Section C

Timber Testing

One morning session in Section C was devoted to papers on the testing of wood, and six papers were presented for discussion. On account of the absence of most of the authors of these papers, the discussion was somewhat limited. We give, then, only brief abstracts of the papers themselves.

McGarvey Cline (U. S. A.) outlined the general scope of investigations conducted by the Forest Products Laboratory of the U. S. Forest Service to determine the properties of the commercial timbers of the United States. The paper describes the program of tests and gives a brief review of the results obtained. W. H. Warren (Australia) presented a similar paper describing tests of the same nature undertaken for the Government of New South Wales on native hardwoods. The tests consist of tests of cubes in compression cut from sections of the tree at various heights from the ground, the strength and elasticity of large and small beams, experiments to determine the relationship between moisture and strength, tensile tests, shearing tests, holding power of nails and hardness tests by the Brinell method. Particular attention was paid to the peculiarities of the tree itself so that the properties of a wood could be traced from the appearances of a growing tree from which that wood is cut. Mr. Warren stated that the tests had been described *in extenso* in a New South Wales government report, which could be obtained by writing to the government offices at Sydney.

G. Janka (Austria) presented a paper describing his modified Brinell ball test as applied to wood tests. This process, first described by the author in 1906, consists of pressing an iron hemisphere into the surface of the wood a depth equal to its radius and recording the required pressure as the hardness of the wood. He found that the hardness corresponds generally to the crushing strength. W. H. Warren (Australia) and W. K. Hatt (U. S. A.) stated that this test had been used with some success in their respective countries.

M. Rudeloff (Germany) brought up in a paper the old question of whether wood should be tested in small specimens or large pieces. He argued as follows: The economic value of wood and the permissible stress must be determined by large size testpieces so as to include knots, irregularity of growth, etc. For routine acceptance tests only small specimen testpieces can be used, however, as large testpieces would consume too large a part of the log. Large size tests may be made once for all for each kind of wood so as to secure values for use in design, etc. W. K. Hatt stated that the United States Forestry Service had followed practically this theory and it now considered that its program of tests on large timbers is complete, and that since it knows all it needs to know about large timbers of the common species its activities in the future will be largely devoted to tests on small pieces of wood taken from trees in the forests, with a view to aiding the forester in his sylvicultural problems. Prof. Rudeloff's paper contained a resolution regarding the Tanaka formula for testing wood in large pieces, which resolution was passed by the congress as shown above.

The Danish State Testing Laboratory forwarded a paper describing some bending tests on square-edged and bark-edged timbers, which were the result of a recent government order requiring square-edged planks in builders' scaffolding in place of the usual bark-edged planks. Tests showed that this regulation was not founded on facts for the bark-edged sticks showed higher strength. In accordance with Prof. Rudeloff's paper, these tests proved the necessity for large size pieces where the strength of actual timbers is in question.

One paper on wood preservation was presented by P. Labordère and F. Anstett (France) describing the method of treating wood blocks used in the street pavements of Paris. Experiments to find a treatment for increasing the end-grain crushing strength showed that heating at 130° to 140° C. for three and a half hours, preferably in heavy coal-tar oil, gave a great increase in strength. This increase disappeared on prolonged immersion in water, but impregnation with pitch has been tried successfully to prevent the entrance of water.

Nomenclature of Stress

A. Mesnager (France) for Committee 52 presented a report recommending certain nomenclature for different stresses. This report is embodied in the resolution headed "Some Technical Expressions," printed at the beginning of this article.

Testing Methods

B. Kirsch (Austria) read a paper recommending a revision in the principles for mechanical testing recommended by previous congresses. He said that yield-point should be defined, limit of proportionality should be defined for wood, cement, etc., the relation of kind of test to nature of service is erroneously characterized and recommendations on self-adjusting bearings of testing machines are in error. He recommended that a resolution be adopted appointing a committee to revise the testing methods proposed at the Brussels Congress in 1906. M. Camerman (Belgium) offered an amendment to this resolution proposing that *all* testing methods proposed by the past congresses should be revised by this committee. There was long argument for and against these resolutions, but they both were finally submitted to the Resolutions Committee, who combined them into one resolution, which, for some unexplained reason, was never presented to the final meeting of the congress for action.

F. Schüle and E. Brunner (Switzerland) read a paper entitled "A New Method of Calibrating Testing Machines." This method involves the use of 3x3x½-in. dry pine plates, which are compared in cross-grain crushing strength in the different machines to be calibrated. In three machines of 33, 33 and 55 tons capacity the variation in each series of six tests was about 2%. Commenting upon the method, Prof. A. N. Talbot (U. S. A.) said that this appeared to be a convenient method of testing such machines as take short specimens, but in larger machines, which take longer specimens, a balance of steel, arranged with an extensometer, for measuring deformations, would give results which probably would be closer.

H. I. Hannover (Denmark) presented a paper showing that all experimental evidence is in favor of the view that compression specimens are affected by friction against the bearing plates, which restrains the lateral spread at the end. In discussion Mont Schuyler (U. S. A.) described a machine in use in the St. Louis Municipal Testing Laboratory, from which this effect may be directly measured.

[*To be concluded in next week's issue.*]

A Cloudburst in West Virginia, on Sept. 2, caused the drowning of 20 or more people, and almost completely destroyed the town of Colliers. Other towns less seriously affected are Hollidays Cove, W. Va., and Cherry Valley, Avella and Burgettstown, Penn. On the Pennsylvania R.R. line, between Wheeling Junction and Burgettstown, 14 miles of four-track road were reported completely washed away, and traffic was effectively tied up.

The Burning of Beach Resorts, at Ocean Park and at Venice, about 20 miles from Los Angeles, Calif., on Sept. 3, caused a loss of property, valued at between two and a half and five million dollars, and twelve persons are reported missing. A number of large hotels and piers were destroyed and much damage done in the business section. The houses were largely of wood and a strong wind also helped to spread the fire.

The S.S. "Nantucket" Caught Fire at her pier in Baltimore Harbor, on Sept. 2, and an hour later sank, from the water poured into her to stop the fire. The vessel is one of the fleet of the Merchants and Miners' Transportation Co., and the damage is estimated at between $75,000 and $100,000. The exact cause of the fire is unknown, but its presence was first noticed by a foreman of stevedores who was supervising the unloading of the cargo. Ten lines of hose were quickly brought to bear on the burning portion, and five fire boats were summoned to assist in the fight. Two of the crew are missing and five of the firefighters were injured before the blaze was put out.

An Explosion of Imperialite, a new form of high explosive, being perfected by its inventor, Marquis Imperiali, resulted in the death of the Marquis and the destruction of his factory at Monte Chiari, near Brescia, Italy. The accident occurred on Aug. 29, and was the second disaster at this plant during the past year. In the first explosion, which was less severe, the marquis was badly injured. It had been claimed and proven that neither pounding nor burning would explode this substance, and the inventor stated that it could only be set off by a fulminate of mercury detonator. The details as to the cause of the explosion are not known.

A Butting Collision, between a fast freight and a work train, on the Canadian Pacific Ry., near Mattawa, Ont., on Sept. 1, resulted in the killing of five and the injuring of ten of the work train crew. This train was running caboose first, and doing track ballasting, when it was struck by the freight train. Reports vary as to the responsibility for the accident, some stating that the work train crew were on this track contrary to orders, and others stating that a fault in switching had placed the freight train on the wrong track. Traffic was held up ten hours by the wreck.

A Derailment near Lyndhurst, Wis., on Sept. 1, resulted in the killing of 6 and the injury of 24 of the passengers and train crew. The train, a fast passenger express, on the Lake Shore division of the Chicago & Northwestern Ry., was running at about 30 miles an hour, when it struck a section of track, recently washed out by the cloudburst, which did much damage throughout northern Wisconsin. The locomotive, mail car, baggage car, smoker, and one day coach left the rails and all but the coach were overturned. The General Manager of the road was in the wreck, but escaped injury, and he directed the relief work and the clearing of the tracks.

A Wrecking Train was the cause of a bad wreck on the Pennsylvania R.R. line near Conway, Penn., in which five were killed and eleven injured, among the passengers and the two train crews. The accident occurred on Aug. 30, while the wrecking train was engaged in clearing up after a couple of minor freight-train derailments. A portion of the wrecking derrick projected over the opposite track, and when the Cleveland Flyer, a fast passenger train, went by its locomotive was derailed by the projecting derrick boom ,and six of the seven passenger coaches followed the engine off the track. Fog prevented the passenger engineer from seeing signals that were placed to warn him of the obstruction ahead.

The Washing Out of a Bridge over the Lemonweir River, near Camp Douglas, Wis., caused the wreck of a passenger train on the Chicago, St. Paul, Minneapolis & Omaha R.R., on Sept. 2. Four persons were killed and twenty-six injured, six of them seriously, when the train left the rails and plunged into the flooded river. The accident is peculiar in this respect, that the train, leaving Camp Douglas, had passed safely over the bridge, only a short time before the accident, and was held up further on by another washout. It was while returning to Camp Douglas that the wreck occurred, the bridge having been carried away in the short interval, between the time of first crossing and that of the return trip, probably not exceeding half an hour.

A Collision in the London Subway, in which 18 passengers were slightly injured, occurred on Sept. 4, and was the first collision of any consequence that has happened on that road. The signal and protective system in use, in the London tubes, is entirely automatic except for one thing, the closing of a lever in the driver's box of each train as it leaves a station. It was failure to do this that caused an express to run into the rear end of a local train, standing at the Caledonian Road Station. The driver of the express train, by quick application of the brakes, greatly reduced its speed, and probably thereby prevented a more serious accident.

Wharf Collapse at Panama—A section of wharf at Balboa, Canal Zone, about 185 ft. in length, collapsed at half-past one in the morning of Aug. 17, and the steamship "Newport" moored alongside, sank. No one was killed or injured. The "Newport" which belongs to the Pacific Mail Steamship Co., and is registered in New York, is a single-screw iron steamship of 2,735 tons gross register, 326 ft. long ,38 ft. beam, 24 ft. in depth, and was built at Chester, Pennsylvania, in 1880. It was loaded with about 1,500 tons of general cargo, consigned for the most part to ports of Central America and Mexico, and was due to sail during the afternoon of the 19th. A committee, consisting of Mr. S. B. Williamson, chairman, Lieut. F. Mears, and Mr. W. G. Comber, is investigating the cause of the accident.

The section of wharf which collapsed is a part of the "angle annex," extending at an angle from the land end of the "steel pier" to the coal wharf. The wharf is 60 ft. wide, with heavy timber flooring, and is supported on piles. It was built by the Panama Railroad Company in 1905. Two railway tracks, paralleling it on the land side, are included with it under the corrugated roof and sides. The electrically operated cranes are mounted on a 10-ft. track along the outer edge.

After the first collapse was heard the structure sank steadily. Within about two minutes, two of the steel cargo-handling cranes, which had been opposite the bow of the "Newport", toppled over. One fell inward, toward the center of the collapsing section, while the other fell across the vessel, forward of the wheelhouse. Only the masts, the funnel and the superstructure of the wheelhouse are visible above water at high tide. Immediately on noticing the collapse of the wharf, the policeman on patrol aroused the crew of the "Newport," who escaped to safety. The policeman then reported the disaster to headquarters, from which a report was transmitted to the Chairman and Chief Engineer, and by three o'clock, men and equipment were being assembled for the work of reclamation. Three railway wrecking cranes and derrick barge "No. 19" have been engaged in the removal of debris, and a diver has been ascertaining conditions within and about the submerged vessel. "Canal Record," Aug. 21, 1912.

The Lakes-to-the Gulf Deep Waterway Association will hold its Seventh Annual Convention at Little Rock, Ark., Sept. 24 to 26. W. K. Kavanaugh, of St. Louis, is president of the Association, and Thomas H. Lovelace, of Little Rock, Ark., is secretary.

Another Diesel Engine Motor-Propelled ship is to be built for service on the Great Lakes for the Montreal Transportation Co. According to "The Engineer" of London, the vessel is to have two sets of Diesel engines, each of 300 hp., running at 400 r.p.m. Each engine will drive an alternating current generator and the current generated will be delivered to an induction motor on the propeller shaft running at 80 r.p.m. This system of electric transmission is that patented by Mr. H. A. Mavor, of Glasgow, Scotland. The vessel will have a capacity of 2400 tons on a draft of 14 ft. It is being built by Swan, Hunter and Wigham, Richardson, Ltd., of Wallsend-on-Tyne, England.

Fifty-eight Miles an Hour, attained by the hydroplane "Tech, Jr.," in speed trials on Huntington Bay, Sept. 5, makes a new record for fast speed on the water. The boat is 20 ft. long and has a beam of 7 ft., and her hull below the water line is flat. She was built by Adolph Apel, at Vintnor, N. J., and is driven by an eight-cylinder Sterling engine of 150 hp. When traveling at high speed, the boat is out of the water, from a half to two-thirds of her length, a large part of the time.

The Staten Island Tunnel Route has been adopted by the Public Service Commission, and it will leave the proposed extension of the 4th Ave. Subway, in Brooklyn, at about 65th St., and run under the bay to Staten Island, to a point midway between St. George and Stapleton. Bids have not yet been asked for the construction of this Staten Island Tunnel, but the Commission is now advertising for bids for the construction of the extension of the 4th Ave. Subway, from its present terminus, at 43d St. and 4th Ave., to 39th St .and 4th Ave., Brooklyn, N. Y.

The Rathenau Gold Medal, which was presented to Emil Rathenau, founder and

president of the Allgemeine Electricitäts Gesellschaft of Berlin, Germany, on his seventieth birthday anniversary, has been placed at the disposal of the American Museum of Safety to award annually for the best process or device for promoting health or safeguarding life and limb in the electrical industry. One medal will be made each year from the original die. Competition is to be open to the world, there being only one condition—that the device or process must be exhibited at the American Museum of Safety in New York City.

Wireless Telegraph Service will be instituted between New York City and Norway, according to an announcement of the Marconi Co. of America. The American plant will be owned and operated by the company while the Norwegian station will be government property. The receipts of the two stations are to be pooled and divided equally between the company and the Norwegian government. The company will receive $350,000 for the foreign station, exclusive of site and foundations (about the price to be paid by the British government for each station in its proposed "imperial system" as noted in Engineering News, Aug. 22, 1912), and will secure a royalty of 10% the gross receipts for 25 years.

Forty-two Amendments to the Ohio Constitution, drafted after long debate by a constitutional convention, were submitted to popular vote on Sept. 2. Some of the amendments were of direct interest to civil engineers, contractors and state and local officials in charge of public works. We reprint below a press summary (New York *Times* of Sept. 3) of such of the amendments as are most likely to interest our readers:

6. Initiative and referendum provided.
9. Legislature empowered to enact stringent builders and mechanics' lien law.
10. Legislature empowered to enact laws limiting hours of labor and providing that other sections of the Constitution shall not limit legislative power to establish a minimum wage and sanitary factory regulations.
11. Legislature empowered to create a fund to compensate workmen for occupational diseases and industrial accidents.
12. The present Constitutional provisions in the way of a broad forest and water power conservation removed.
13. Eight-hour day on public work prescribed.
14. Legislature directed to provide means of removing, on complaint and hearing, all accused public officers.
17. Prison contract labor abolished.
22. Labor injunctions restricted to protect physical property. No punishment for contempt in labor cases without jury trial.
25. Authorizes use of voting machines.
26. Preferential primaries, extending to the Presidency of the United States.
29. Extends State bond limits to $50,000,000 for intercounty wagon roads.
31. Superintendent of Public Works, appointed by Governor, to replace elective Board of Public Works.
32. Poll taxes prohibited. Income taxes and inheritance taxes authorized. Mineral production excises authorized.
33. State supervision over issuance of corporate securities authorized. Legislature may alter charters granted to corporations.
35. State empowered to do its own printing.
37. Competitive examinations and civil service regulations for appointments to all State, county, and city positions prescribed.
38. Present constitutional obstacles to legislative regulations of billboard advertising on private property removed.
39. Initiative for constitutional amendments provided.
40. Cities and towns given power to own and operate public utilities. May sell light and power to neighbors to the extent of one-half of total production. [In addition, we understand that this amendment, which comprised 14 sections, authorized cities and villages to frame, enact and amend their own charters—Ed.]
41. Amendments passed shall take effect Jan. 1, 1913. Those passed shall prevail over anything inconsistent in present Constitution.

At first reports it appeared that all the amendments voted in our summary had been adopted, but returns from the several districts indicated that the "good roads" amendment and also the one providing for an eight-hour day on public works were hanging in the balance.

A Municipal Water Conservation Exhibit will be held by the city of Philadelphia for two weeks, beginning about Oct. 7. The exhibit will be held in the court yard of the City Hall and will include an official display by the Department of Public Works. In addition, the local manufacturing and jobbing trade of the city has been invited to "show every device and apparatus pertaining to the use, but particularly to the conservation of water," which they can bring to the front. Besides this, a letter has been sent to the mayor of each large city east of the Mississippi River calling attention to the exhibit and making the following statements:

It is the idea of the Department of Public Works to make this exhibit entirely along popular lines, easily understood by everyone, and to so educate the consumer of water that the enormous waste which now obtains in this city may be reduced thereby to a minimum.

We give you this advance information for the reason that in your city you may have conducted a popular campaign against water waste, or at any rate, may be able to advise us what steps are being taken, if any, toward lessening the carelessness with which the average citizen uses the municipal water-supply. Any data on the subject which will show the experience of your city in this matter of eliminating unnecessary waste of water we shall be glad to receive and possibly make use of in our forthcoming exhibit.

The following committee has been appointed by Mayor Blankenburg in connection with the exhibit: John G. Fleck, president of the Plumbing Supply Association of Philadelphia; Powell Evans, authority on fire waste of the Merchant & Evans Co.; Mrs. Frank Miles Day, first vice-president of the Civic Club; J. W. Ledoux, chief engineer of the American Pipe & Construction Co.; J. Harvey Borton, general manager of the Haines, Jones & Cadbury Co.; Mrs. Edwin C. Grice, president of the Home and School League; Charles W. Masland, manufacturer; Miss F. Arline Tryon, 1931 Race St. Further information may be secured from H. W. Benjamin, Secretary General Committee, Room 790 City Hall, Philadelphia, Penn.

Personals

Mr. J. O. Wright, chief drainage engineer of the state of Florida, has resigned. For some time past, Mr. Wright has been in charge of the work of draining the Everglades.

Mr. James W. Waber has been appointed Engineer in Charge of Construction of the St. Paul & Kansas City Short Line R.R. (Rock Island Lines), with office at Carlisle, Iowa. He succeeds the late W. C. Beach.

Mr. S. R. Heakes, a mining engineer and one time manager of the Kerr Lake Mine at Cobalt, Ont., was ordained a member of the Anglican clergy, at London, Ont., on Aug. 25. Mr. Heakes will serve as curate of the Cronyn Memorial Church of London.

Mr. A. Norman has been appointed General Manager of the Freeport Ry. & Light Co. of Freeport, Ill., representing the Samuel Insull interests, which have recently purchased the company. Mr. Norman has been connected with electrical engineering work under Mr. Insull for a number of years.

Mr. E. G. Nee has been elected Vice-President and Chief Engineer of the Mexican Telephone & Telegraph Co., with headquarters at Boston, Mass. Prior to his election, Mr. Nee was head engineer in charge of installation work for the same company, and he is succeeded by Mr. W. B. Beveridge, Assoc. Am. Inst. E. E.

Mr. Samuel M. Felton, M. Am. Soc. C. E., was appointed receiver of the Pere Marquette R.R. on Aug. 26, by Judge Sessions of the United States District Court. Mr. Felton succeeds Mr. Newman Erb., who recently resigned, and he brings to the place a wide experience, gained as a railway official on a number of large roads, and as receiver for the Cincinnati, New Orleans & Texas Pacific Ry. and for the Columbus, Sandus[illegible] & Hocking R.R.

Mr. Robert F. Pack, Assoc. Am. Inst. E. E., has announced his resignation as General Manager of the Toronto Electric Light Co., to take effect the first week in September. Mr. Pack has been with the Toronto Electric Light Co. about 20 years, serving successively in the capacities of Comptroller, Secretary, and General Manager. It is understood that he will take charge of large electrical development enterprises for an important European financial house.

Professor E. J. McCaustland, M. Am. Soc. C. E., and recently appointed a member of the Washington State Board of Health, as noted in our issue of April 4, 1912, has just had a narrow escape from drowning, in connection with the prosecution of some water-power investigations on the Deschutes River in Oregon. Two experienced boatmen who accompanied him were drowned, when the boat was swamped in the rapids, and Professor McCaustland himself was not rescued until over three hours after the accident.

Mr. Michael M. O'Shaughnessy, M. Am. Soc. C. E., and Chief Engineer of the Southern California Mountain Water Co., has been appointed City Engineer of San Francisco, Calif., by Mayor Rolph. Mr. O'Shaughnessy succeeds Mr. Marsden Manson, resigned, and his position carries with it the highest salary on the regular city payroll, $15,000 per year. He took his degree of Bachelor of Engineering at the Royal University of Dublin, in 1884, and has had a wide experience, as a constructing and consulting engineer, on railroad, hydraulic and municipal engineering projects on the Pacific Coast and in Hawaii.

Major J. J. Morrow, of the Army Engineer Corps, has been appointed chairman of the Alaska Railroad Commission by President Taft. The other members appointed to the Commission are Mr. Alfred H. Brooks, of the United States Geological Survey, Mr. Leonard M. Cox, civil engineer of the Navy, and Mr. Colin M. Ingersoll, consulting bridge engineer of New York. The members of the Commission, with the exception of Major Morrow, who is stationed on the Pacific Coast, will proceed directly to Alaska, where they will traverse the present railroad lines and examine into projected routes from the coast into the interior.

Dr. Conrad Matschoss, Privatdocent at the Technical High School of Berlin, is visiting the United States to study the

methods in use in American engineering schools and American practice in industrial education. Dr. Matschoss comes as the representative of the Verein Deutscher Ingenieure, of which society he is the official historian, and is engaged in preparing the history of various fields of engineering development. After several days' stay in New York City, Dr. Matschoss is to make a tour of the country, visiting Philadelphia, Washington, Pittsburgh, Columbus, Cincinnati, St. Louis, Minneapolis, Madison, Chicago, Urbana, Cleveland, Buffalo, Niagara Falls, Schenectady, Boston, New Haven, etc. During his stay in the United States, Dr. Matschoss may be addressed in care of the headquarters of the American Society of Mechanical Engineers, 29 West 39th St., New York City.

Obituary

Paul t'Serstevens, Secretary of the International Union of Tramways and Light Railways, located at Brussels, Belgium, died, Aug. 8, at Aix-la-Chapelle. He had been secretary of the society for 11 years, and apparently had overworked himself in taking charge of the convention held in July at Christiania, Norway.

E. Harrison Symington, Assoc. Am. Soc. M. E., died at Baltimore, Md., on Sept. 5, at the age of 34. For several years Mr. Symington had been the Western representative of T. H. Symington & Co., of Baltimore, with headquarters in Chicago, Ill., and he was an active member of engineering and social clubs in both Chicago and Baltimore.

Wesley Rhodes, assistant chief engineer for the Fore River Shipbuilding Co., died at his home at Quincy, Mass., on Sept. 4, at the age of 46. He came to this company from the Cramps' shipyards in Philadelphia about a year ago, to become chief draftsman, and in a few months was raised to the position he held at the time of his death.

W. C. Beach, expert locating engineer for the Rock Island System, died of cancer of the stomach, on Aug. 25, in the Passavante Hospital, Chicago, Ill. Mr. Beach served for many years with the Atchison, Topeka & Santa Fe Ry. and with the Rock Island System, in railroad location and construction work, and at the time of his death, he was engaged in the construction of the St. Paul & Kansas City Short Line R.R., which road he located two years ago. His acquaintance throughout the Southwest was very extensive.

Frederick J. Mayer, M. Am. Soc. M. E., and prominent gas engineer, died at his home in New York, on Sept. 2, after a brief illness. He was born at Bremerhaven, Germany, on July 4, 1853, was educated at the University of Stuttgart, and saw active service in the Franco-Prussian War. In 1870 he came to this country and entered the employ of the Bartlett Hayward Co., of Baltimore, Md., rising in their service from draftsman to chief engineer. In 1906 he organized and established the Didier-March Co. in the United States, and became its general manager. Mr. Mayer was a tireless worker, invented many improvements in the manufacture of illuminating gas, and was an active member of many important engineering societies and social clubs. He is survived by his wife.

W J McGee, noted anthropologist, geologist and hydrologist, and prominent member of the United States Geological Survey, died at the Cosmos Club in Washington, D. C., on Sept. 4, from a cancerous growth, brought on by an accident several weeks ago. Dr. McGee was born in Dubuque County, Iowa, on Apr. 17, 1853, and, although one of the leading scientists of today, he was almost entirely self-educated. While working on a farm, between 1863 and 1873, he studied Latin, higher mathematics, astronomy and surveying, and read law, and his versatility is shown by the fact that, at different periods of his career, he was an inventor and manufacturer of agricultural implements, a practicing lawyer, an explorer, a geologic and topographic surveyor, and an author and lecturer on geology, archaeology, ethnology and anthropology. He was a close friend and associate of Gifford Pinchot, and had charge of the collection of technical data and the arrangement of the program of the 1st National Conservation Congress, held at the White House in 1907. At the time of his death he was Secretary of the Inland Waterways Commission, President of the American Anthropological Association and one of the editors of the "National Geographic Magazine." The provisions of Dr. McGee's will are unusual, in that he bequeathed his body and brain for dissection and preservation, in the interests of science.

Engineering Societies

COMING MEETINGS

INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.
Sept. 4 at Washington.
Sept. 6-13 at New York City. Secy., Bernhard C. Hesse, 25 Broad St., New York.

ILLUMINATING ENGINEERING SOCIETY.
Sept. 16-19. Annual convention at Niagara Falls, Canada. Secy., P. S. Millar, 29 West 39th St., New York.

PACIFIC COAST GAS ASSOCIATION.
Sept. 17-19. Annual meeting at San Diego, Calif. Secy., John A. Britton, 445 Suter St., San Francisco, Calif.

NEW ENGLAND WATER WORKS ASSOCIATION.
Sept. 18-20. Annual convention at Washington, D. C. Secy., Willard Kent, Narragansett Pier, R. I.

AMERICAN PUBLIC HEALTH ASSOCIATION.
Sept. 18-20. Annual meeting at Washington, D. C. Secy., Selskar M. Gunn, 755 Boylston St., Boston, Mass.

INTERNATIONAL CONGRESS ON HYGIENE AND DEMOGRAPHY.
Sept. 23-28. Fifteenth congress at Washington, D. C. Secy., John S. Fulton, Senate Annex, Washington, D. C.

AMERICAN FOUNDRYMEN'S ASSOCIATION.
Sept. 24-26. Annual convention at Buffalo, N. Y. Secy., R. D. Moldenke, Watchung, N. J.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.
Sept. 25-28. Annual convention at Indianapolis, Ind. Secy., R. C. Harris, City Hall, Toronto, Ont.

NATIONAL IRRIGATION CONGRESS.
Sept. 30-Oct. 3. Annual meeting at Salt Lake City, Utah. Secy., Arthur Hooker, Salt Lake City.

AMERICAN ASSOCIATION FOR HIGHWAY IMPROVEMENTS.
Sept. 30-Oct. 5. Annual convention at Atlantic City, N. J. Secy., G. E. Pennybacker, Jr., Colorado Bldg., Washington, D. C.

NATIONAL CONSERVATION CONGRESS.
Oct. 1-4. Annual meeting at Indianapolis, Ind. Secy., Thos. R. Ship, Indianapolis, Ind.

AMERICAN ELECTRIC RAILWAY ASSOCIATION.
Oct. 7-11. Annual convention at Chicago, Ill. Secy., H. C. Donecker, 29 W. 39th St., N. Y. City.

RAILWAY SIGNAL ASSOCIATION.
Oct. 8-11. Annual Convention at Quebec, Canada. Secy., C. C. Rosenberg, Times Bldg., Bethlehem, Penn.

AMERICAN RAILWAY BRIDGE & BUILDING ASSOCIATION.
Oct. 15-17. Annual convention at Baltimore, Md. Secy., C. A. Lichty, 226 Jackson Blvd., Chicago, Ill.

AMERICAN GAS INSTITUTE.
Oct. 16-18. Annual meeting at Atlantic City, N. J. Secy., Geo. G. Ramsdell, 29 West 39th St., New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.
Oct. 21-25. Annual meeting at Chicago, Ill. Secy., T. A. Andreucetti, C. & N. W. Ry., Chicago, Ill.

American Society of Civil Engineers—At the regular meeting of the Society, Sept. 4, a paper by Ernest McCullough, entitled "Engineering Education in Its Relation to Training for Engineering Work," was discussed.

Union of Canadian Municipalities—The 12th annual convention of the Union was held at Windsor, Ont., on Aug. 27-28. Among the more important subjects discussed were the following: "Equitable Municipal Taxation," by T. A. Clarke; "The Georgian Bay Canal and Its Water," by Mayor Hopewell, Ottawa; "The Price of Cement," by Controller Harvey, Winnipeg; "Winnipeg's Hydro-electric Power Plant," by J. W. Cockburn; and "Municipal Government by Commission," by S. M. Wickett. The secretary-treasurer of the Union is W. D. Lighthall, Westmount, Que.

American Civic Association—The eighth annual convention of the Association will be held at Baltimore, Md., Nov. 19-22, and a comprehensive program is being prepared. Among the problems discussed will be city planning, national and state parks, street illumination, smoke and billboard nuisances, and the house fly, and particular attention will be paid to the problems that confront small cities. The Association secretary is Richard B. Watrous, Union Trust Building, Washington, D. C.

American Road Congress—At the annual convention at Atlantic City, N. J., on Sept. 30, to Oct. 5, the following organizations will participate in the program: American Association for Highway Improvement; American Automobile Association; National Association of Road Machinery and Material Builders; American Bar Association; Society for the Promotion of Engineering Education. The various sessions of the Congress will deal with the subject of road improvement from the engineering, legislative, administrative, and economic standpoints, and papers will be rendered on these phases of the problem; also an exposition of national and state exhibits will be held. More detailed account of the program, and of facilities for accommodating guests can be obtained from the Congress secretary, J. E. Pennybacker, Jr., Colorado Building, Washington, D. C.

New England Water Works Association—The following papers will be read at the 31st annual convention of the Association at Washington, D. C., Sept. 18-20: "State Control of the Design and Construction of Dams and Reservoirs; Actual Practice in Eastern Connecticut," by C. E. Chandler; "Certain Legal Aspects of Water Power Development in Maine," by C. C. Babb; "State Control of Dams in Pennsylvania," by Prof. F. P. McKibben; "Reasonable Requirements Imposed Upon Water-Works Systems by the Fire Protection Problem," by Clarence Goldsmith; "The Organization and Administration of a Supply Bureau," by E. C. Church; and "State Regulation of Public Utilities," by Morris Knowles. Further details may be obtained from Willard Kent, 715 Tremont Temple, Boston, Mass., secretary of the Association.